FUHUA

User Manual

Part One

IED Model Design

V 1.5

2015-07

FUHUA

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For more information please visit http://iedmodeler.com or contact us at info@fuhuatech.com.

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1. Introduction

The IED Modeler/Designer is a comprehensive IED oriented SCL modelling tool for IEC 61850/61400 and companion standards. It has been designed to keep pace with the evolution of standards.

Model Designer, as one of our core products of tool suite is designed to address all the features which are required by different type of users, including IEC 61850 Standard developers, IED vendors, stack vendors, researchers, engineers, utilities companies and people who are interested in applying Model Driven Architecture in system design. With feedbacks from a diversity of users, we keep on developing new features to pill the "pain" confronted when applying IEC 61850/61400 into production. It was born on a mission to help enjoy life in your professional career!

The user manual is composed of four parts, but they are independent and not in sequence.

✓ Part One: IED Model Design

This part is the fundamental. It covers details about installation, introduction to GUI layout, system settings, project management, create/import/modify/export ICD/CID/IID, extract CID from SCD, and generation of TEMPLATE ICD etc. The **Intelligent Creation** features to save you a lot of time and energy in building error-free IED model, such as customizing data types, creation of LNs of different LNodeTypes, creation of DataSet and Control Blocks, initializing DOI values and configuring Communication parameters etc. All those jobs are very convenient to fulfil with help of user friendly Wizards. In addition it also introduces how to batch edit Attribute Values and Element Values using external tools like **Excel**; The Search Utilities is designed to be helpful in searching project items. It uses Fuzzy search algorithm, allowing context search of documentation for each Element and Attribute.

✓ Part Two: Domain Design

This part will introduce you a very comfortable and much higher level of Domain design by utilizing UML technologies. Like other UML tools in the market, Domain design is based on Diagrams. With this tool on hand, you will never feel like asking Domain support from anyone any more. Bet you urgently require Edition 2.0 package for Wind Power, you can home-brew it within one-two hours or even faster if you are an IEC member who is in charge of designing this domain. Within this part Data Type Diagram and Domain Diagram will be introduced, which are much like Class Diagram and Component Diagram in UML, but much more powerful and convenient.

✓ Part Three: IED Model Extension

This part will introduce how to embed private model information into your SCL without breaking any rules defined by IEC 61850-6. Knowing that SCL is lack of PLC logic equations and internal mappings and many others so on. It also doesn't address non-IEC 61850 and vendor-specific

parameters configuration and that all those information are essential to run an application. To do this, we have to turn to model extension according to IEC 61850-6. Model Designer can give you a cutting-edge, vendor-independent, flexible and programmable way to accomplish that.

✓ Part Four: IED Model Validation

This part will introduce Schema Check, Integrity Check and Semantic Check against rules defined by Standards. Schema Check is the most popular feature used nowadays and users tend to believe that if Schema Check is passed, their SCL is error-free. But experiences tell us it sounds too good to be true. Why? To fully tell you the reason, I have to write a book about XML Schema defined by W3C. But that is out of the scope of this manual, here I can only tell the reason is because Schema Check are blind to many types of errors in SCL dynamic structures and semantic constraints.

Give you one of the most typical example which I guess you are unaware of:

<FCDA lnClass="MMXU" fc="MX" daName="PhV.phsA.cVal.mag.i" lnInst="1" ldInst="LDPQ"/>

<FCDA lnClass="MMXU" fc="MX" daName="A.phsA.cVal.mag.i" lnInst="1" ldInst="LDPQ"/>

The Schema Check is OK about the two DataSet entries above. But they are actually incorrect according to IEC 61850-6. Because PhV.phsA is DO.SDO, not DA. So they should be corrected to

<FCDA lnClass="MMXU" fc="MX" doName=" PhV.phsA" daName="cVal.mag.i" lnInst="1" ldInst="LDPQ"/>

<FCDA lnClass="MMXU" fc="MX" doName="A.phsA" daName="cVal.mag.i" lnInst="1" ldInst="LDPQ"/>

To our surprise is MOST of the stack suppliers “accept” this type of errors. In other words, most of the IEDs in the market are running against the rule defined by IEC 61850-6. This is also the reason why IED Model Validation deserves an independent part of user manual.

The good news is that Model Designer offers Integrity Check which can detect errors which are blind to Schema Check.

Semantic Check is a feature we will introduce in the future.

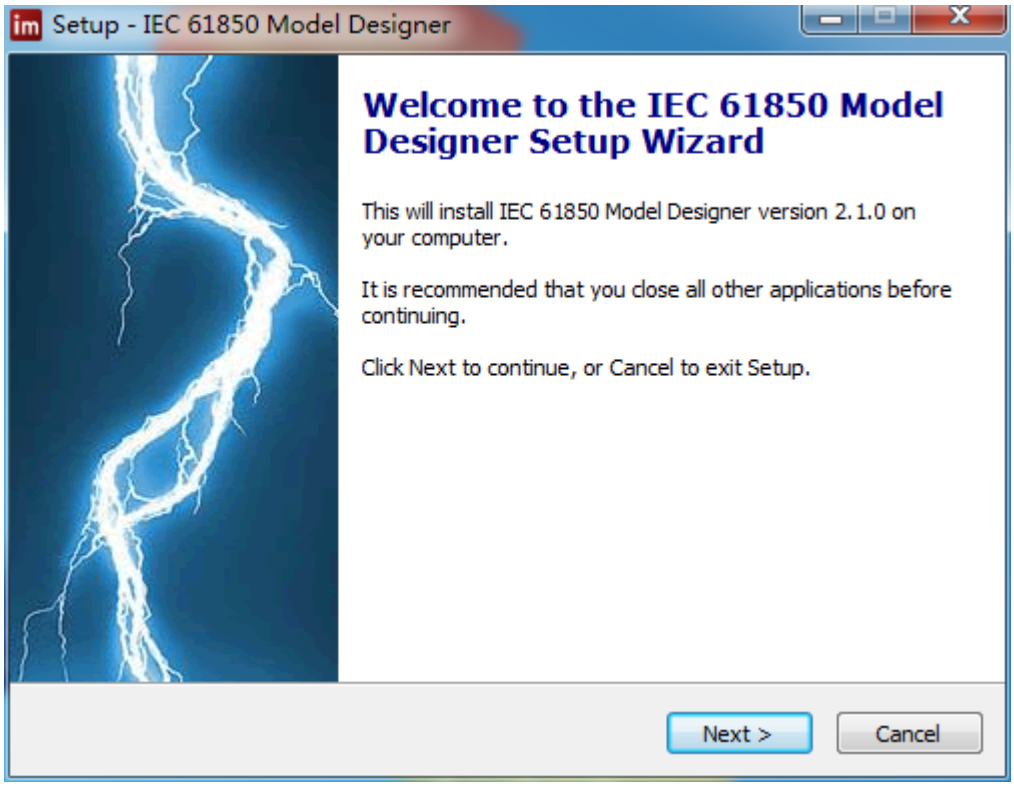
2. Installation

2.1 Environment

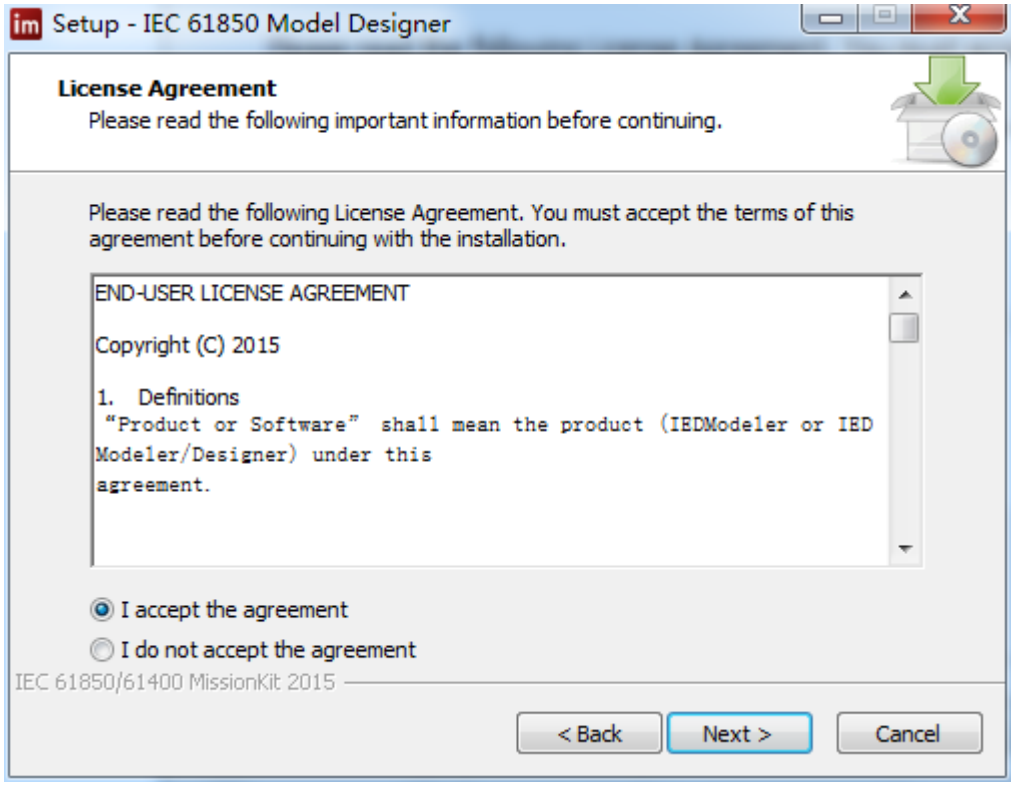
Items	Requirement	Comment
OS	XP /Win7/Win8/Higher	32Bit/64Bit Compatible
Memory	2G or Above	4G/8G recommended

2.2 Install Steps

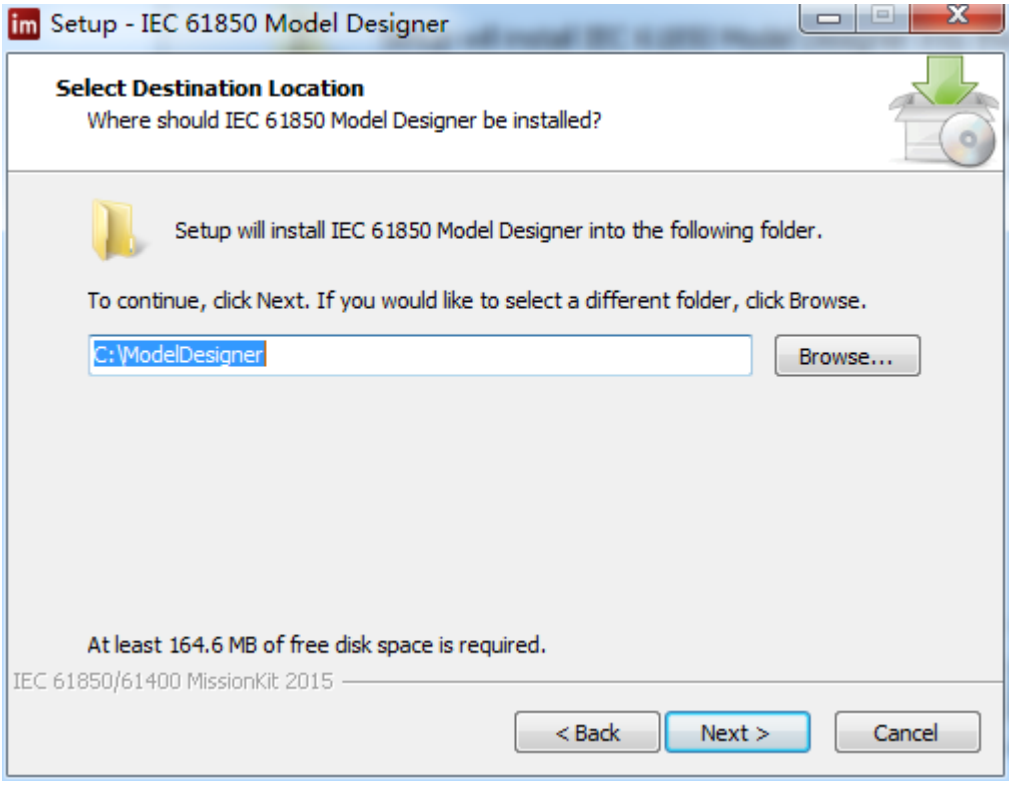
1. Run the Installer by Double Click


Setup - IEC 61850 Model Designer
Welcome to the IEC 61850 Model Designer Setup Wizard
This will install IEC 61850 Model Designer version 2.1.0 on your computer.
It is recommended that you close all other applications before continuing.
Click Next to continue, or Cancel to exit Setup.
Next >
Cancel

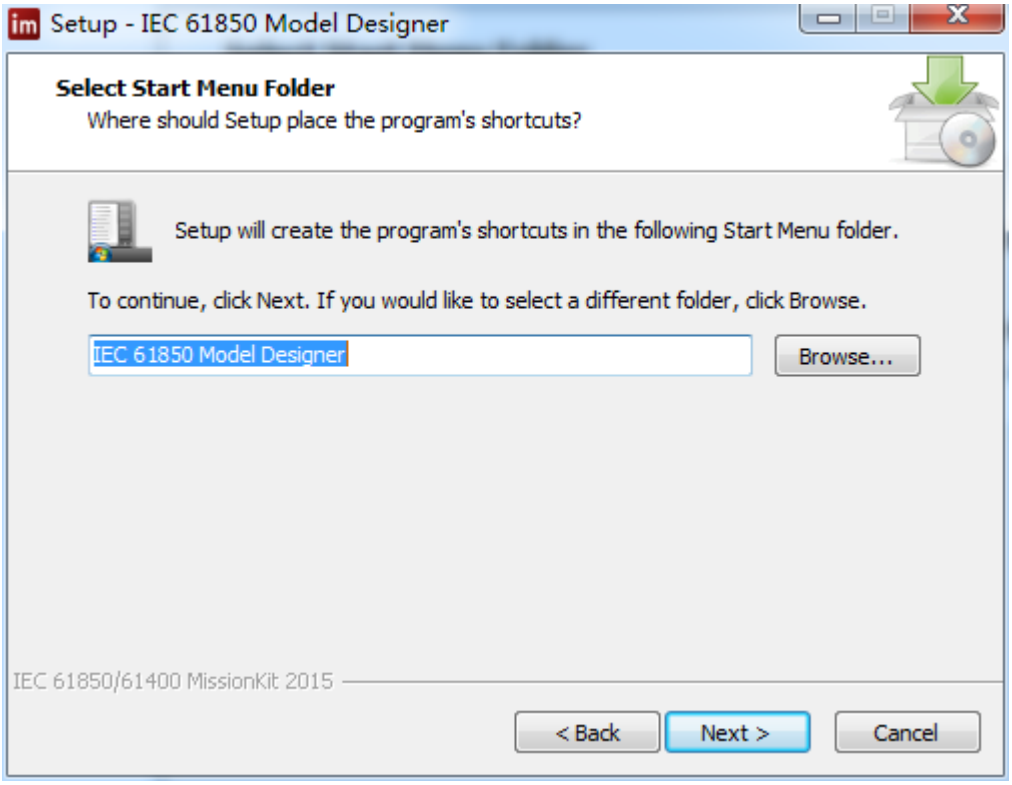
2. License Agreement


Setup - IEC 61850 Model Designer
License Agreement
Please read the following important information before continuing.
Please read the following License Agreement. You must accept the terms of this agreement before continuing with the installation.
END-USER LICENSE AGREEMENT
Copyright (C) 2015
1. Definitions
"Product or Software" shall mean the product (IEDModeler or IED Modeler/Designer) under this agreement.
I accept the agreement
I do not accept the agreement
IEC 61850/61400 MissionKit 2015
< Back
Next >
Cancel

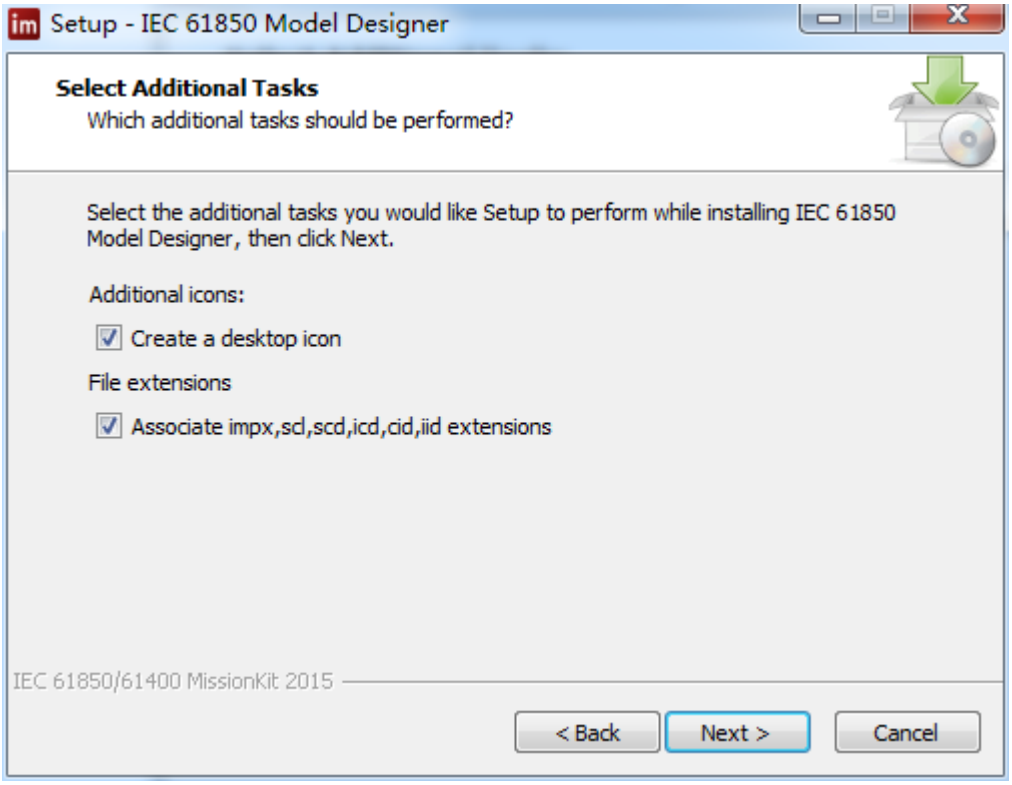
3. Select Destination Location


Setup - IEC 61850 Model Designer
Select Destination Location
Where should IEC 61850 Model Designer be installed?
Setup will install IEC 61850 Model Designer into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
C:\ModelDesigner
Browse...
At least 164.6 MB of free disk space is required.
IEC 61850/61400 MissionKit 2015
< Back
Next >
Cancel

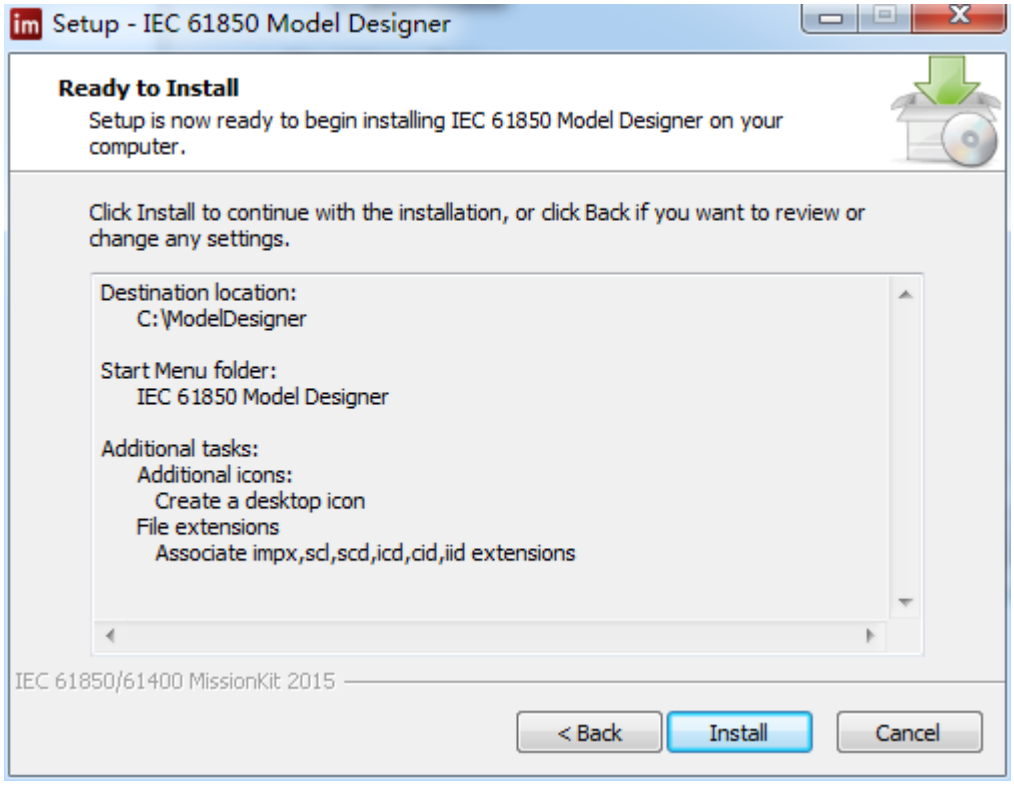
4. Select “Start Menu Folder”


Setup - IEC 61850 Model Designer
Select Start Menu Folder
Where should Setup place the program's shortcuts?
Setup will create the program's shortcuts in the following Start Menu folder.
To continue, click Next. If you would like to select a different folder, click Browse.
IEC 61850 Model Designer
Browse...
IEC 61850/61400 MissionKit 2015
< Back
Next >
Cancel

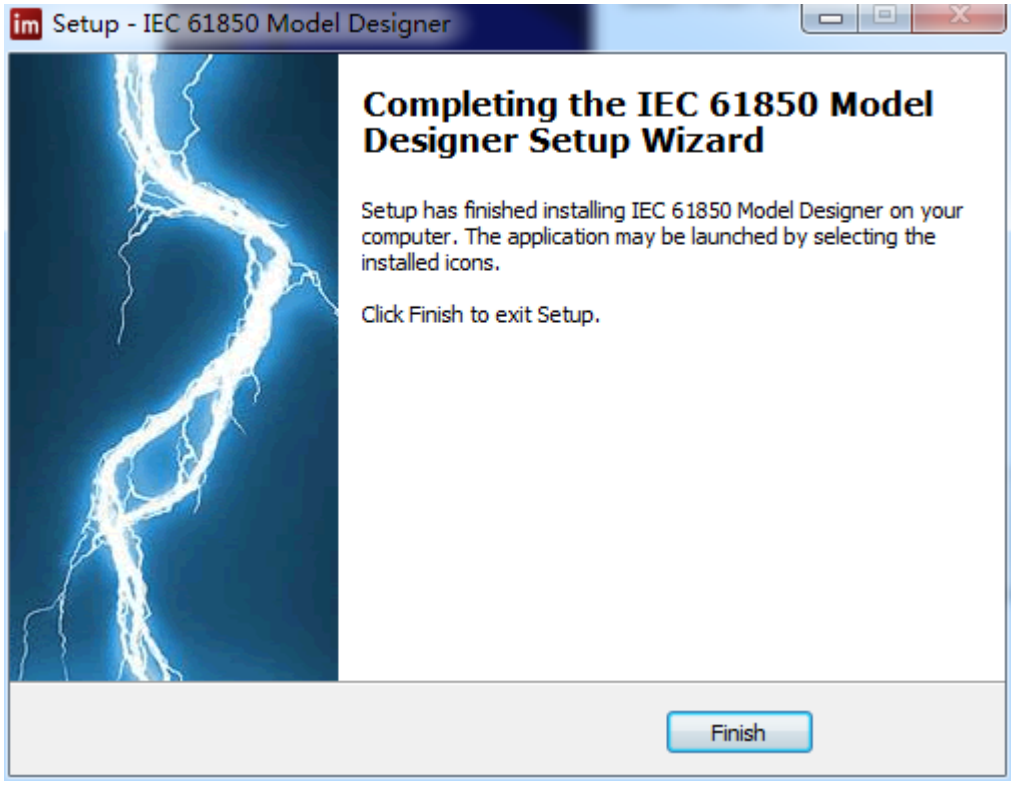
5. Select Additional Tasks


Setup - IEC 61850 Model Designer
Select Additional Tasks
Which additional tasks should be performed?
Select the additional tasks you would like Setup to perform while installing IEC 61850 Model Designer, then click Next.
Additional icons:
Create a desktop icon
File extensions
Associate impx,scl,scd,icd,cid,iid extensions
IEC 61850/61400 MissionKit 2015
< Back
Next >
Cancel

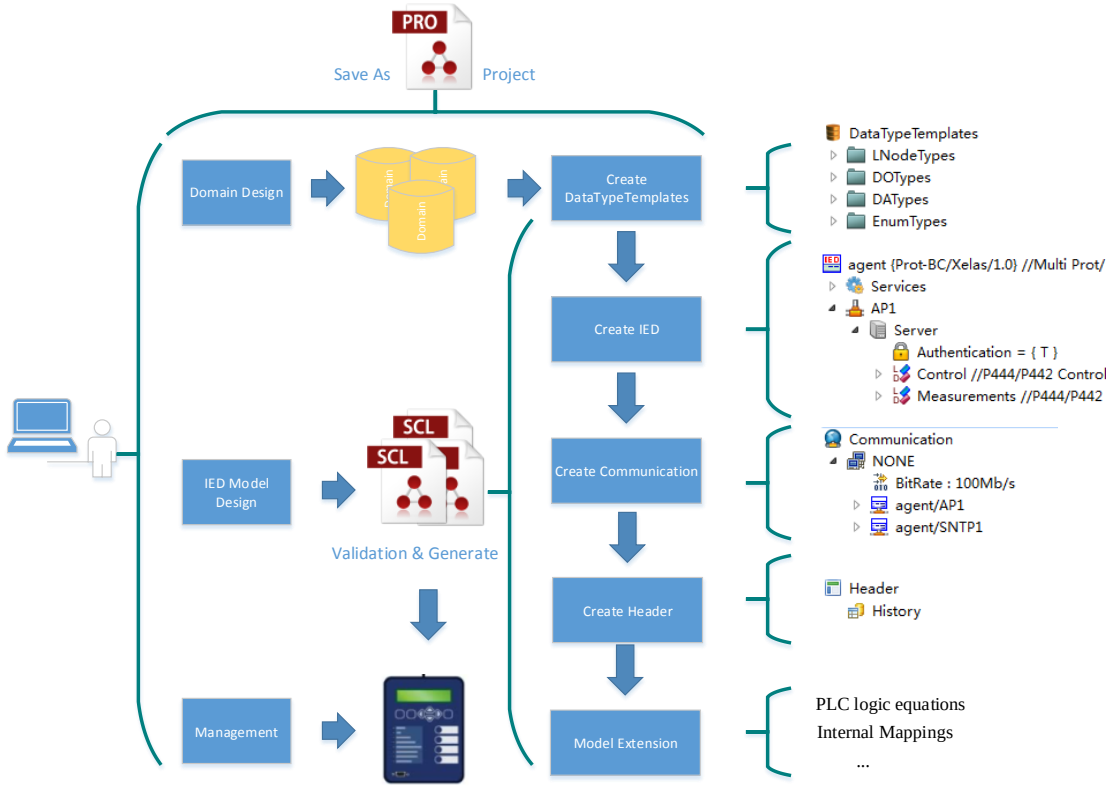
6. Press Install when Ready


Setup - IEC 61850 Model Designer
Ready to Install
Setup is now ready to begin installing IEC 61850 Model Designer on your computer.
Click Install to continue with the installation, or click Back if you want to review or change any settings.
Destination location:
C:\ModelDesigner
Start Menu folder:
IEC 61850 Model Designer
Additional tasks:
Additional icons:
Create a desktop icon
File extensions
Associate impx,scl,scd,icd,cid,iid extensions
IEC 61850/61400 MissionKit 2015
< Back
Install
Cancel

7. Click Finish


Setup - IEC 61850 Model Designer
Completing the IEC 61850 Model Designer Setup Wizard
Setup has finished installing IEC 61850 Model Designer on your computer. The application may be launched by selecting the installed icons.
Click Finish to exit Setup.
Finish

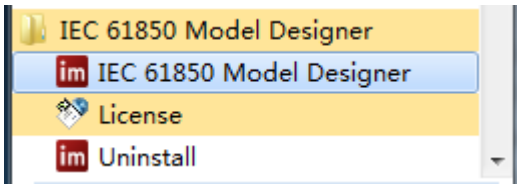
3. IED Model Design



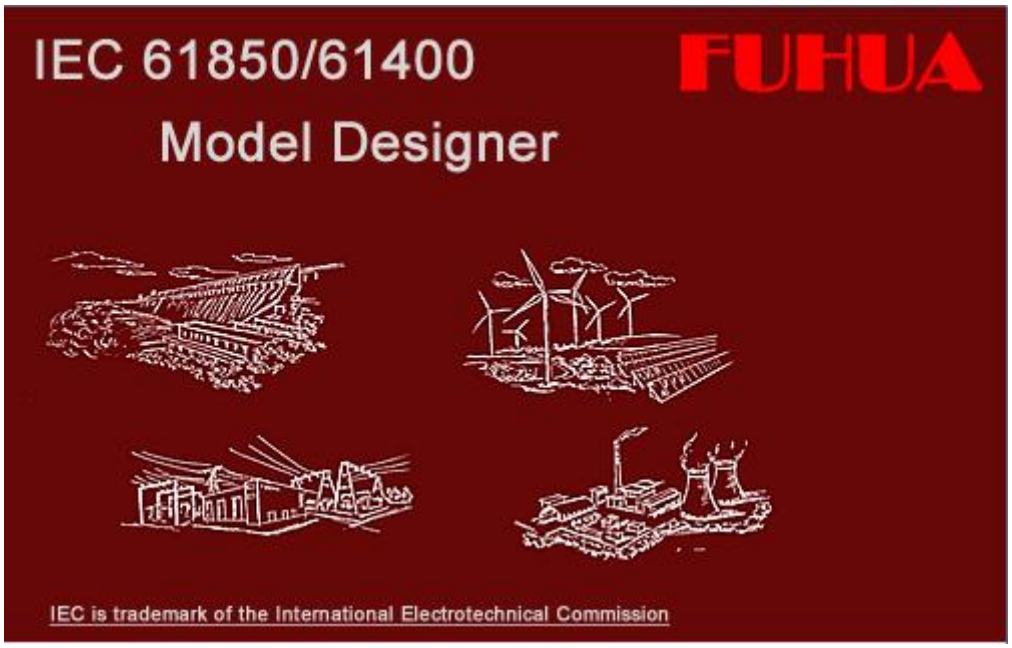
IED Model Design is IED oriented and it is supposed to cover all the features required to streamline the processes of IED model development. It can offer you full access (no blind zone) to the manipulation of SCL model.

3.1 Start the Application

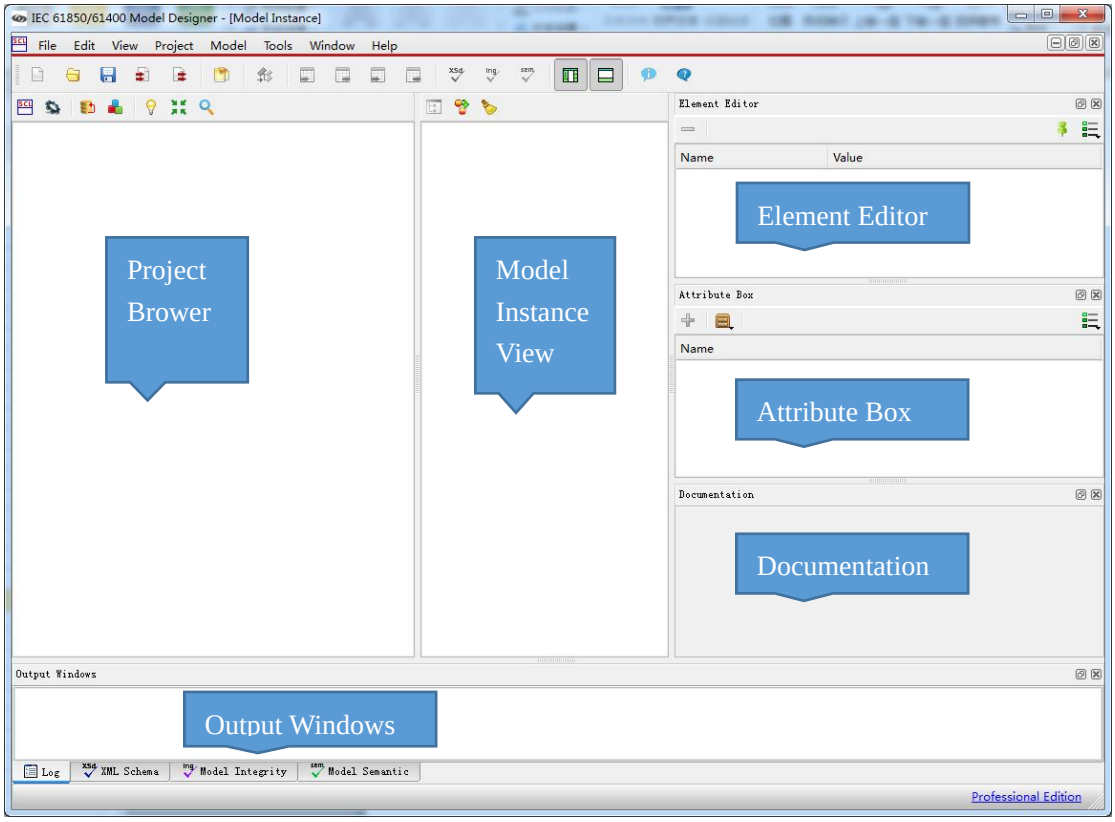
3.1.1. Run the Application from “Start Menu”



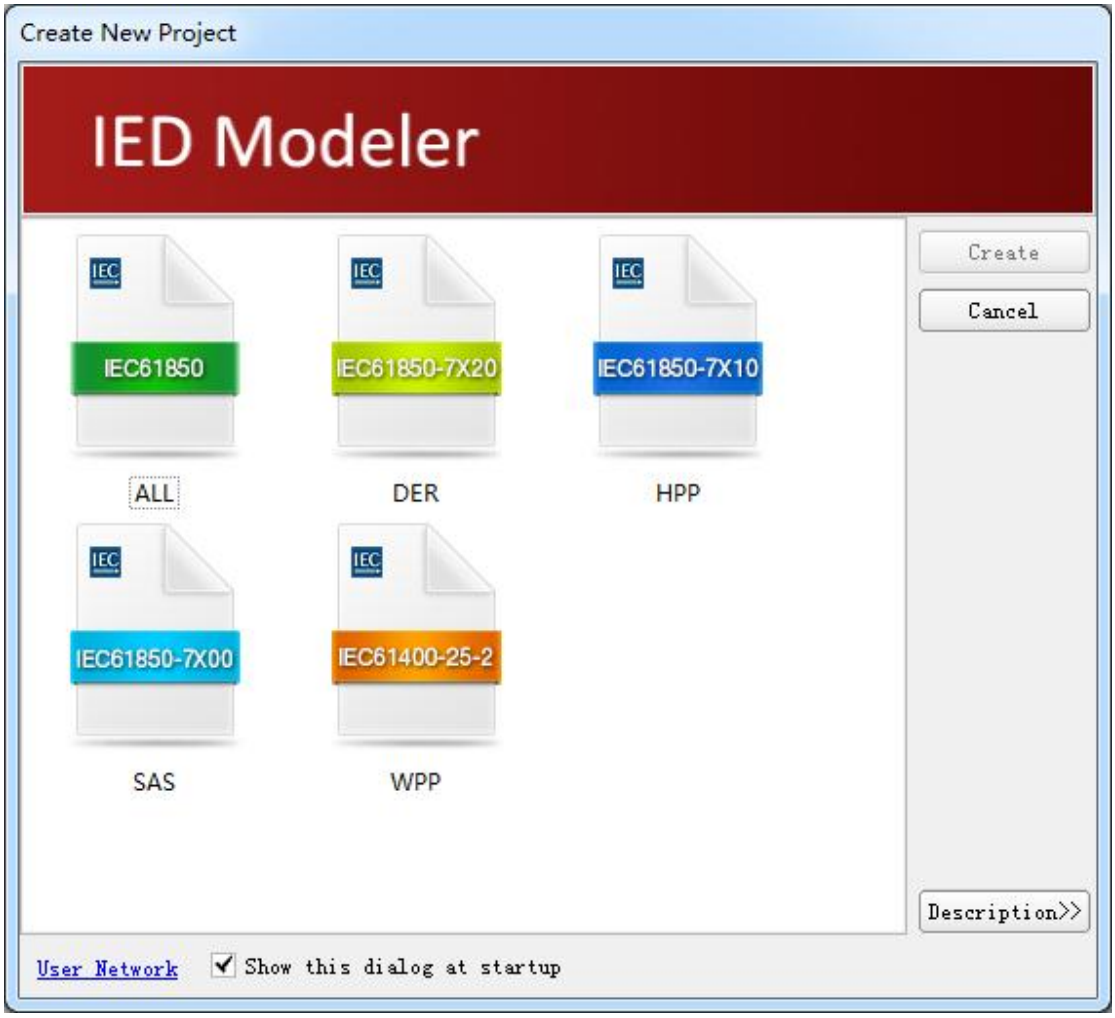
3.1.2. Splash Screen



3.2 The Main GUI Layout



3.2.1. Create New Project



The project wizard window appears when the application is opened. To avoid this wizard at startup uncheck "**Show this dialog at startup**".

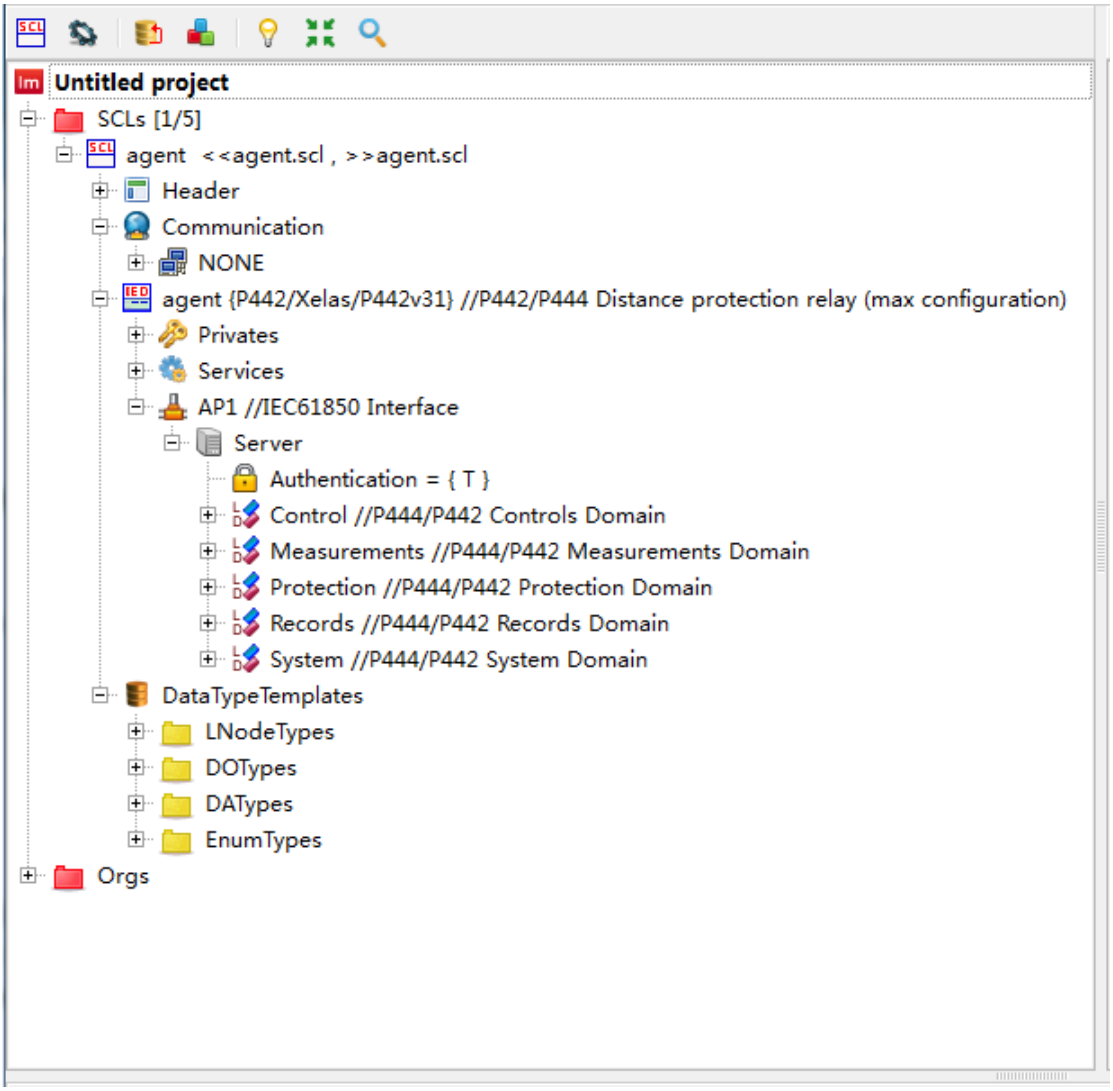
User Network : Link to our website

Description>> : Show/hide project description of the current selected template

Create : Create current selected project (or double click the template icon)

Cancel : Quit the project wizard.

3.2.2. Project Browser



Project Browser provides an easy way to manipulate the project tree. A project can contain multiple SCL files （ICD/CID/IID）or domains. **Domains** are defined in accordance with the IEC 61850/61400 standards; compatible user **Domains** may be derived from standard domains or created from **DataTypeTemplates** of an existing SCL.

Note: 90% of operations are performed through Project Browser either directly or indirectly.

: Create a SCL

: Create a domain

: Browse or edit namespaces used by current project

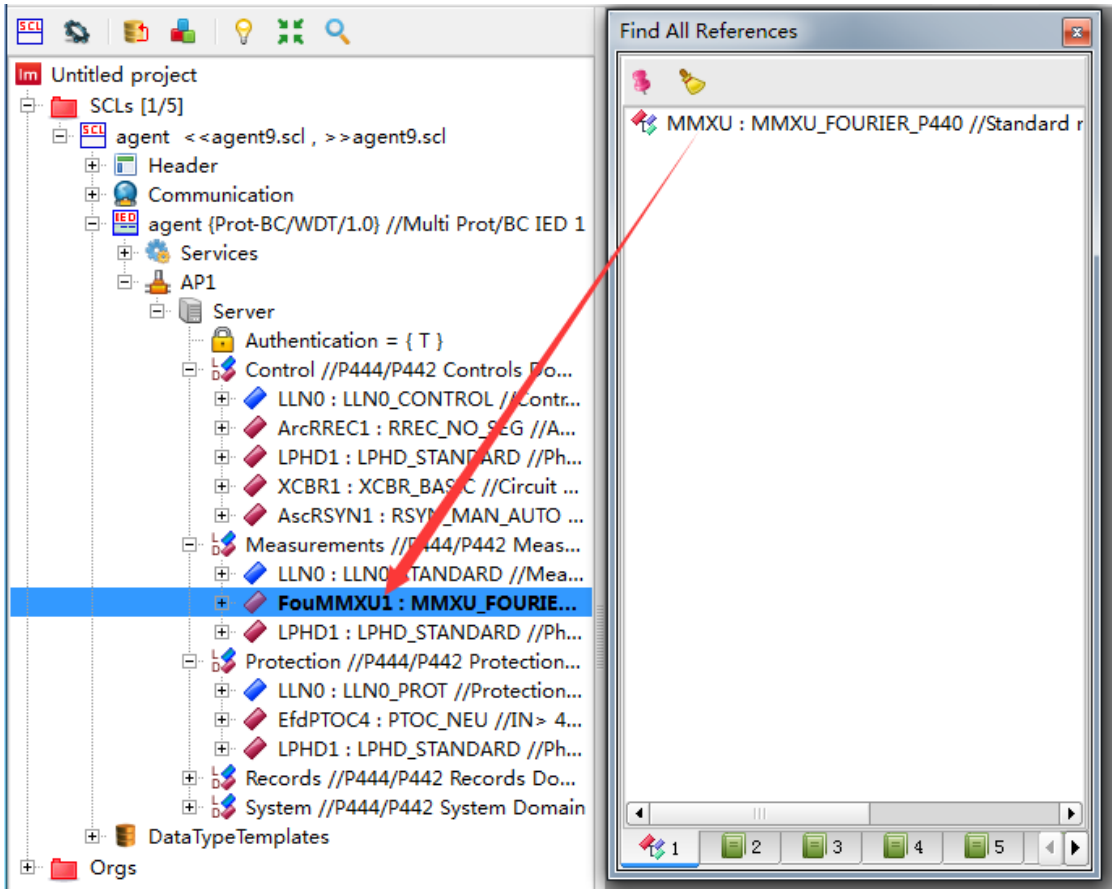
: Edit **Project Settings**

: Go to Project current item

: Collapse all items of project tree

: Search project items

3.2.3. Find All References

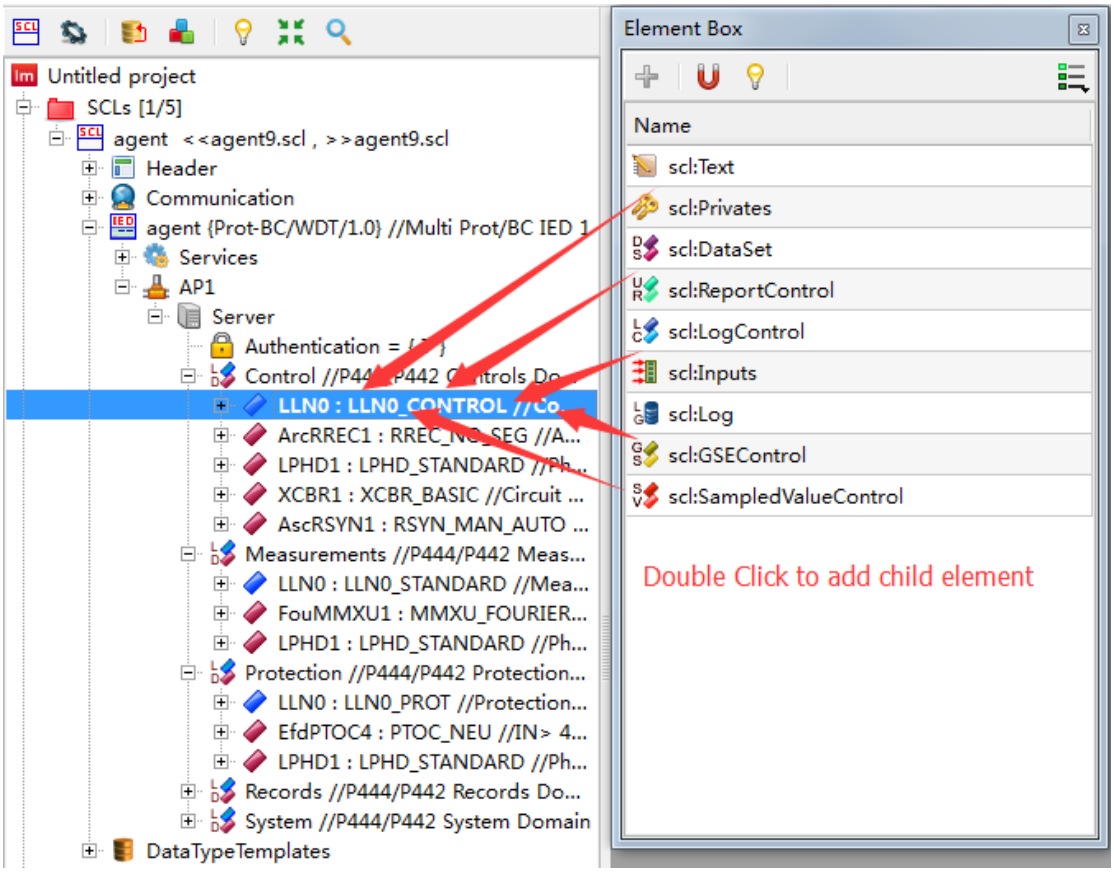


Most IEC 61850-6 SCL Elements are inter-dependent. This means that a change made to one Element may affect others. **Find All References** helps detect the inter-relationships.

Find All References (picture above) enumerates all related Elements in the current active page. The button is used to pinpoint the current enumerated Elements of the current active page. Users can switch to another page to enumerate inter-dependent Elements for other project tree Elements.

Element A	Inter-dependent	Element B
LNodeType	A <------> B	LN
DoType	A <------> B	DO SDO
DAType	A <------> B	DA BDA
EnumType	A <------> B	DA BDA

3.2.4. Element Box



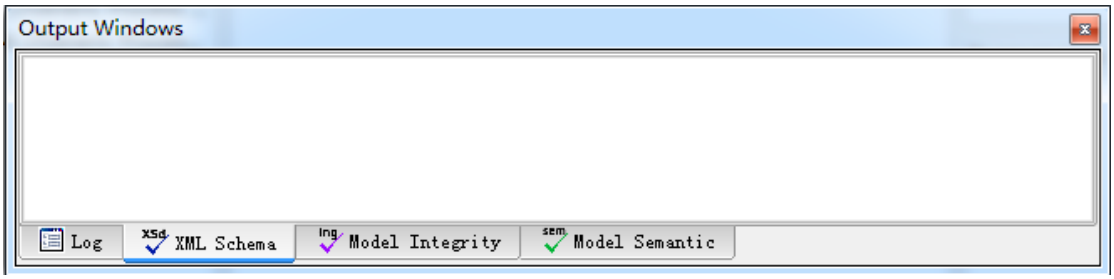
Element Box is used to create child Elements of the project tree Elements. The Intelligent Creation feature uses advanced algorithms to protect users from breaking any rules defined in IEC 61850-6. All creatable child nodes of the current selected project tree Element are listed in the box.

: Add child Element (or double click the child Element)

：Keep track of the latest added element

：Go to Project current Element

3.2.5. Output Windows



There are four sub-windows in **Output Windows**;

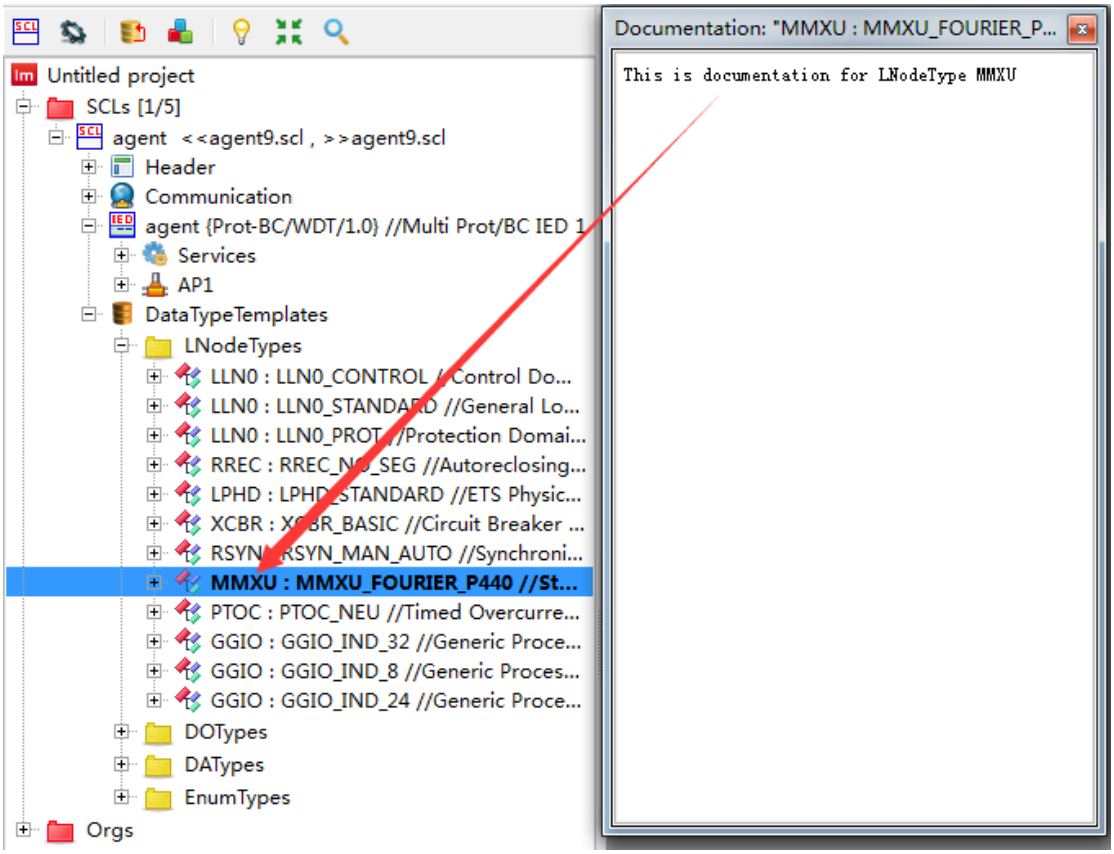
Log: Record messages/operations performed by users

XML Schema: SCL Schema check against IEC 61850-6

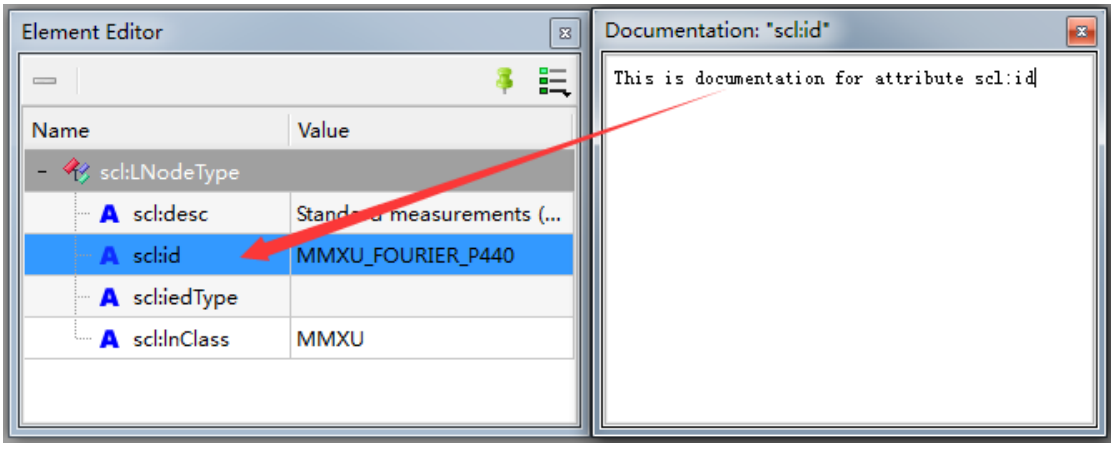
Model Integrity: Check against errors which cannot be detected by XML Schema check

Model Semantic: Check against Semantics defined in IEC 61850

3.2.6. Documentation

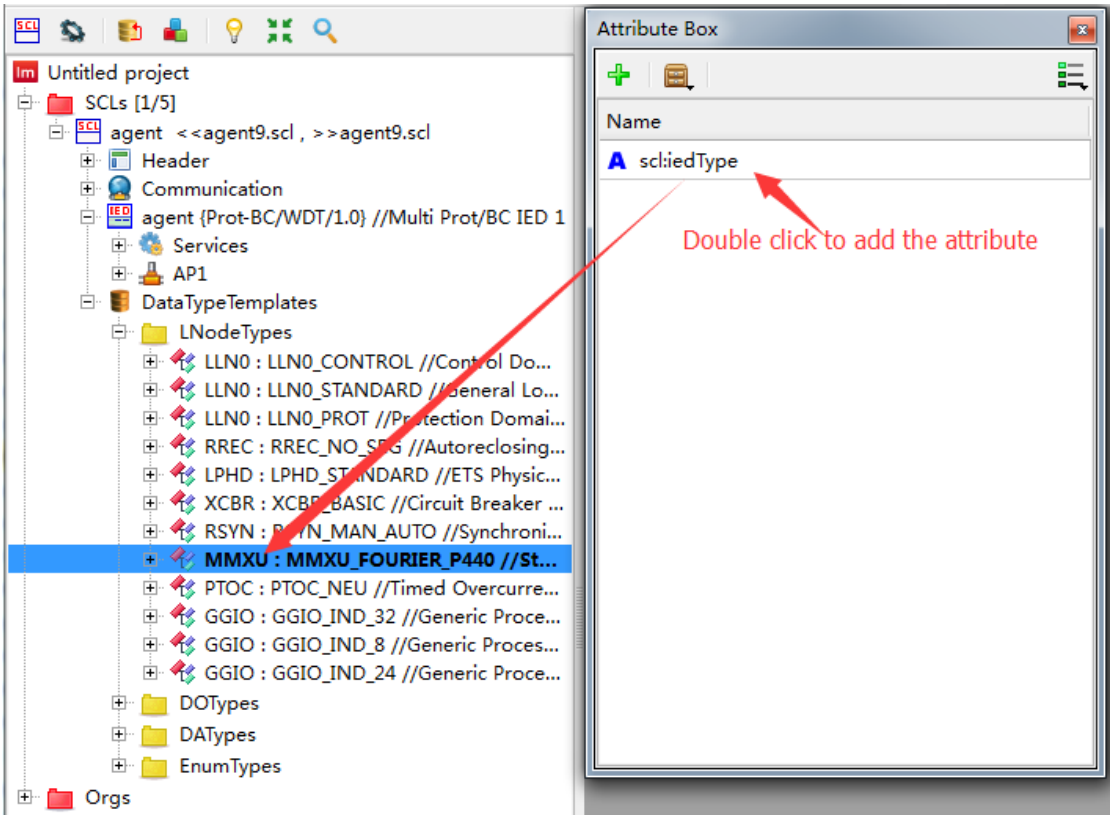


Each Element can be documented through **Documentation** window.



Each attribute of an element can also be documented by making use of the **Element Editor**. The current selected attribute will activate the **Documentation** window and wait for user to input the documentation details.

3.2.7. Attribute Box



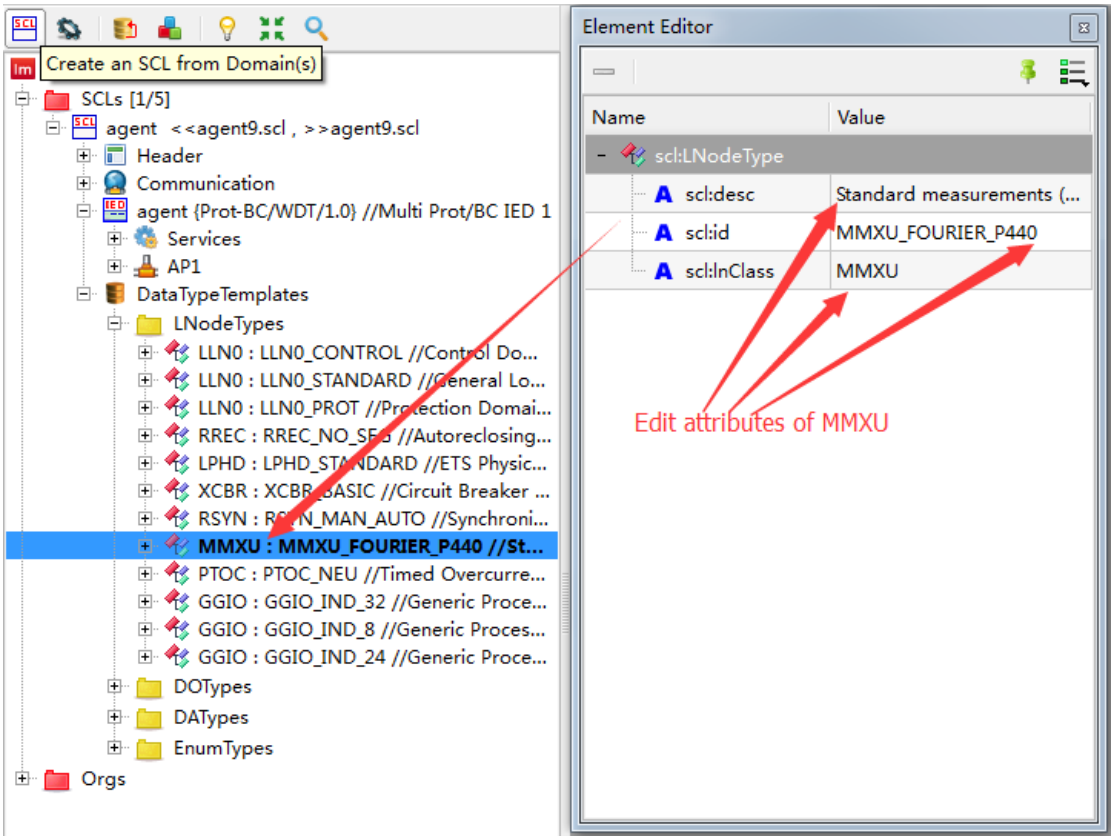
Attribute Box is used to add optional attributes to the selected element in the project tree.

: Add the selected attribute (or double click the attribute)

: Import a group of attributes from Private Namespaces defined in XML Schema file(s)

: Show/hide the other data columns

3.2.8. Element Editor



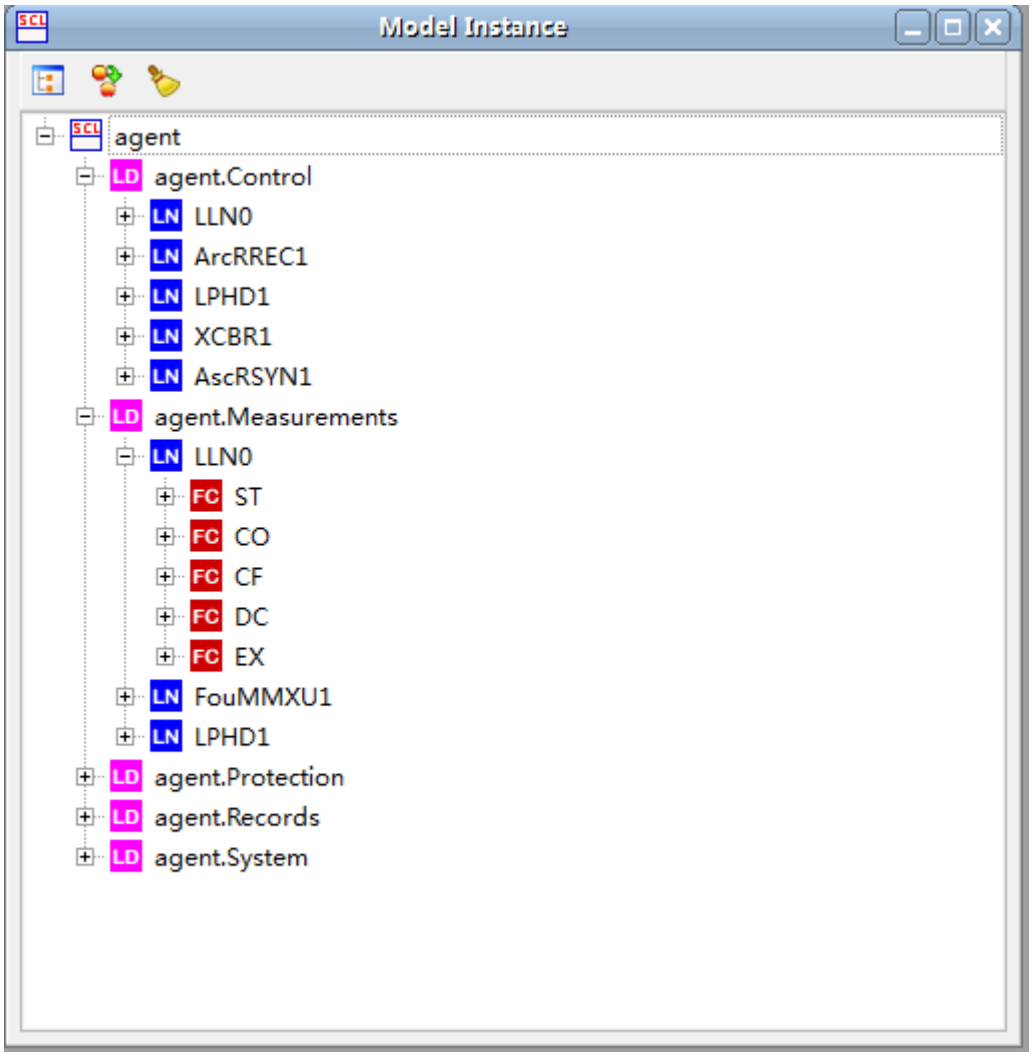
Element Editor is a type aware editor. The value fields will create a user friendly value editor to interact with user's input, preventing errors caused by invalid data.

: Delete the selected attribute (or double click the attribute)

: Always display the **Element Editor**

: Show/hide the other data columns

3.2.9. Model Instance



Each **SCL** can be instantiated through the **Model Instance** window. Currently the instantiated model doesn't include any instances of any **Control Blocks/DataSet/Log** defined by IEC 61850-6. It ONLY contains Data Instances defined by Data Types of **DataTypeTemplates**.

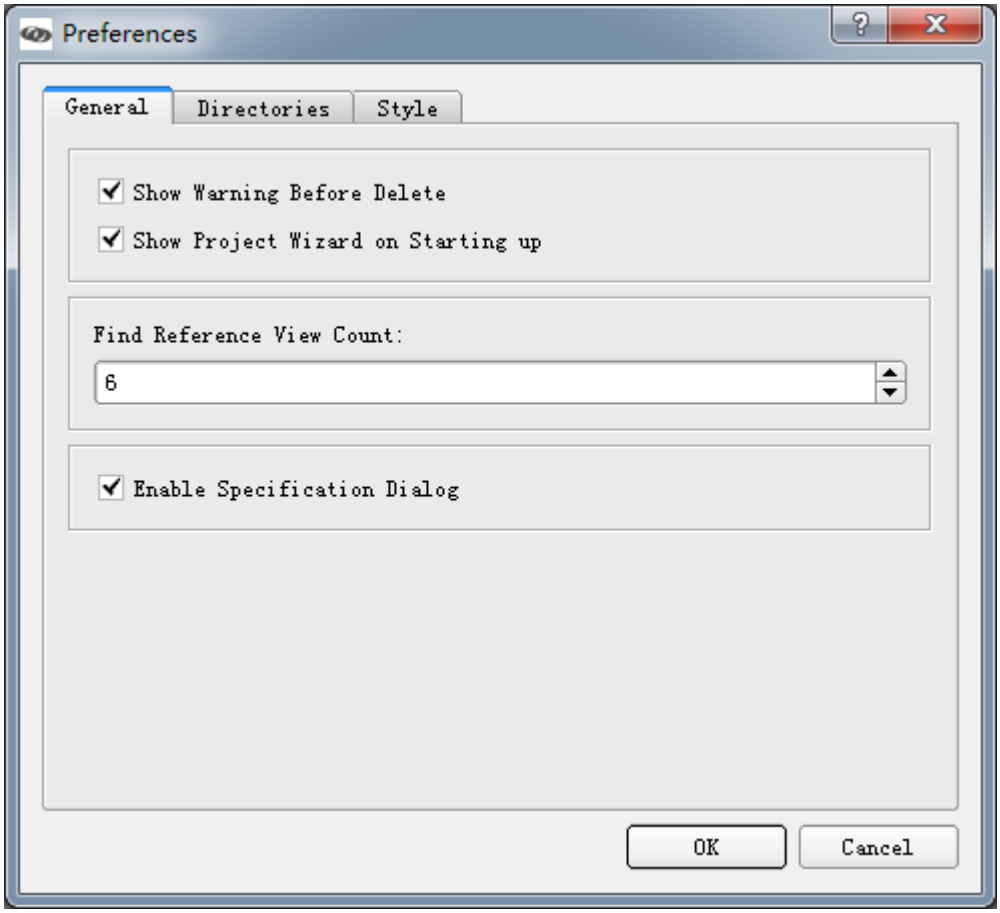
: Trigger model instantiation

: Switch between MMS mapped model instance and IEC61850 ACSI instance (ACSI is more general use case)

: To clear Model Instance

3.3 System Settings

Choose **Edit->Preferences…**



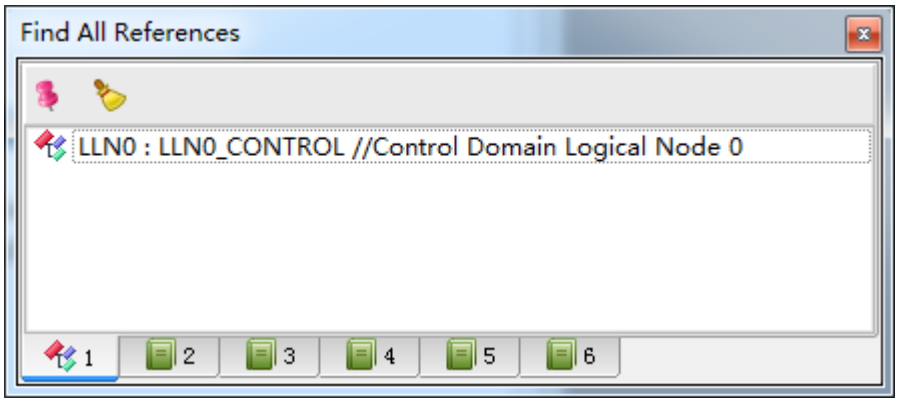
There are three pages in **Preferences** dialog:

➢ General Page

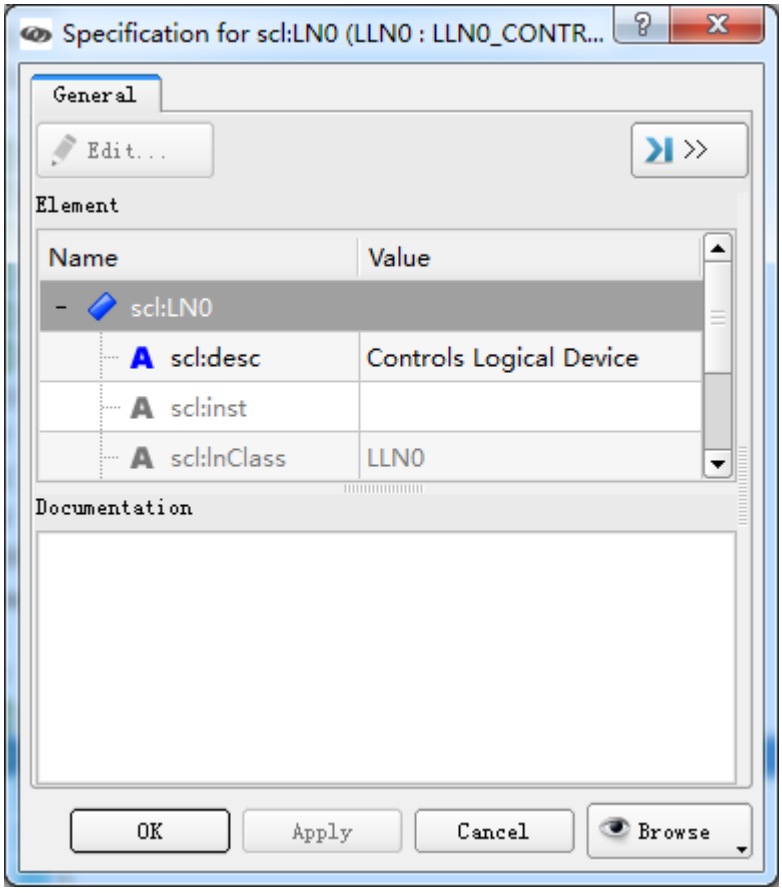
When "**Show Warning Before Delete**" is checked the tool will ask you for confirmation each time an item is deleted from **Project Browser.**

When "**Show Project Wizard on Starting up**" is checked the **Project Wizard** will be displayed automatically at startup.

"**Find Reference View Count**" defines how many pages will be generated when the application is started up (six pages is configured below, readjust count as necessary):

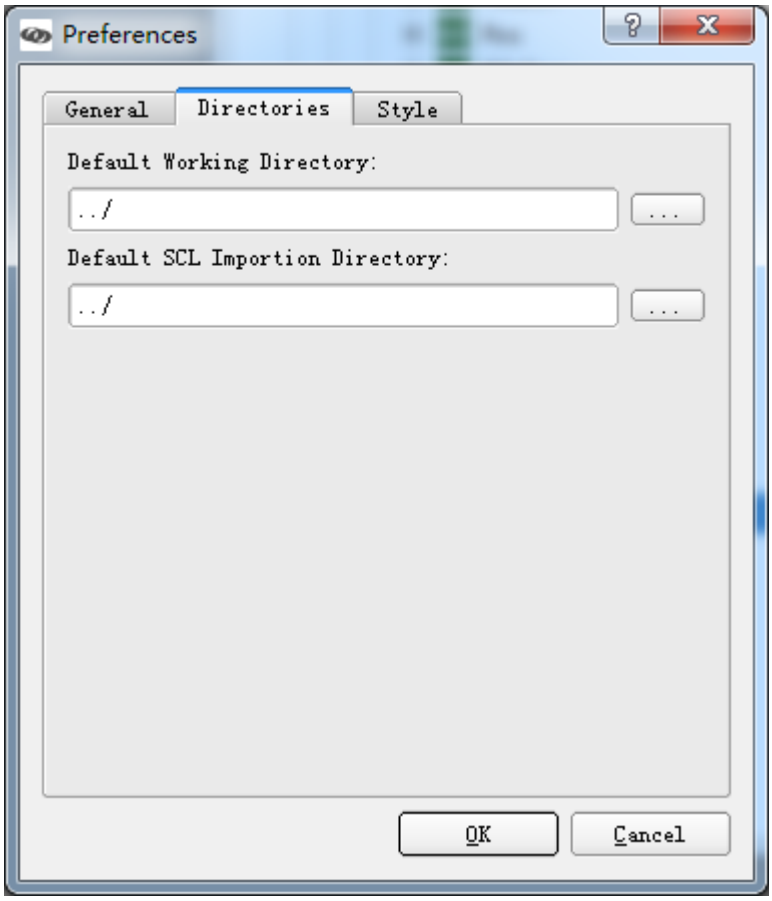


When "**Enable Specification Dialog**" is checked, double clicking on any **Project Browser** item will trigger a **Modeless Specification Dialog**; the **Element Editor**, **Attribute Box** and **Documentation** will disappear from the main window automatically.



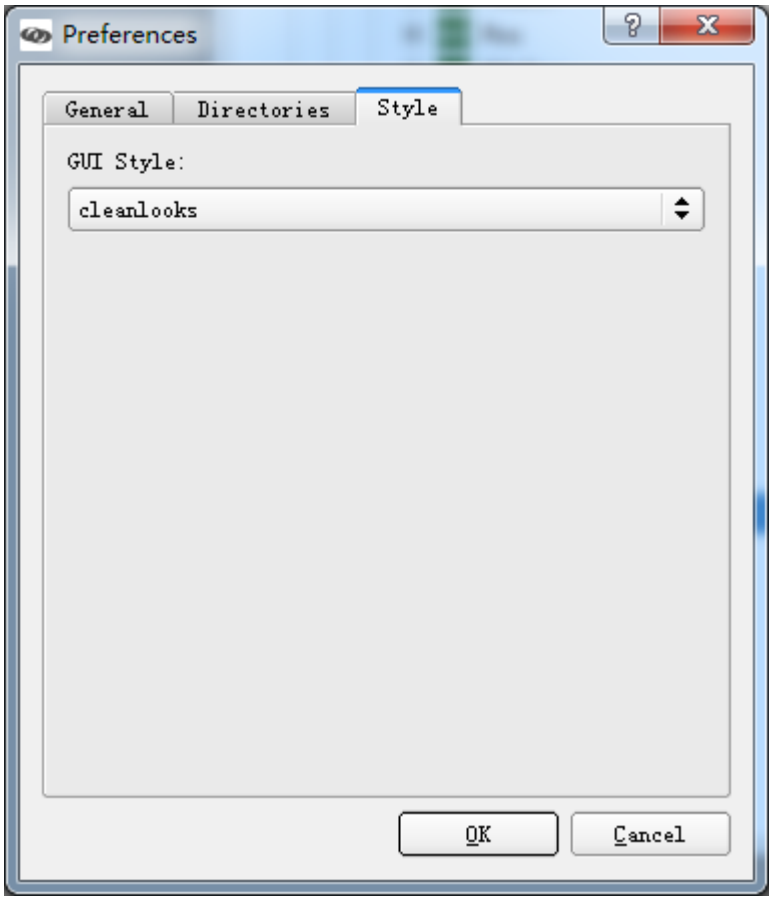
Modeless Specification Dialog is useful for editing multiple elements at the same time. This also makes it possible to integrate extra views to edit/render elements.

➢ Directories Page



In the **Directories** page, "**Default Working Directory**" specifies the default path to store project file while "**Default SCL Importation Directory**" specifies the default path used to import SCL files.

➢ Style Page

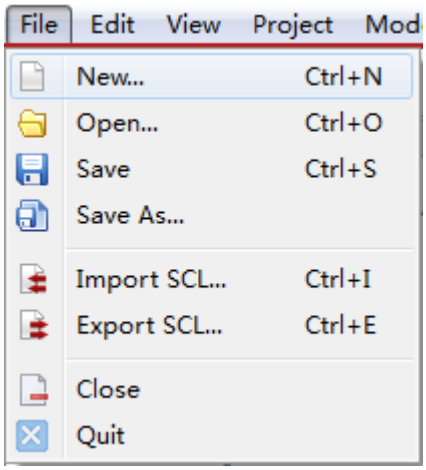


In the **Style** page, users can change the GUI appearance to their taste. There are six styles supported. These are **cde**, **default**, **windows**, **motif**, **plastique** and **cleanlooks**.

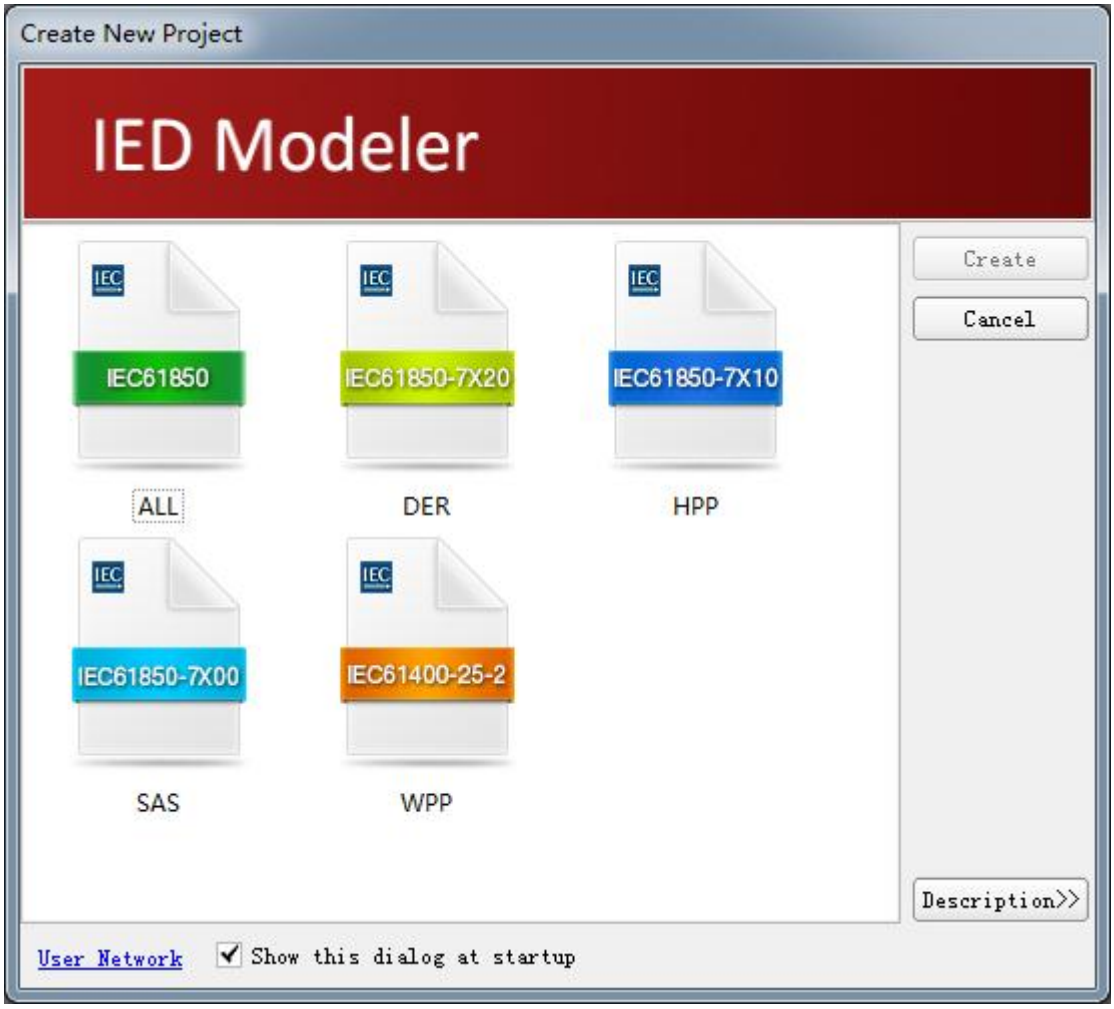
3.4 Create Project

- Step One

Choose **File->New…**

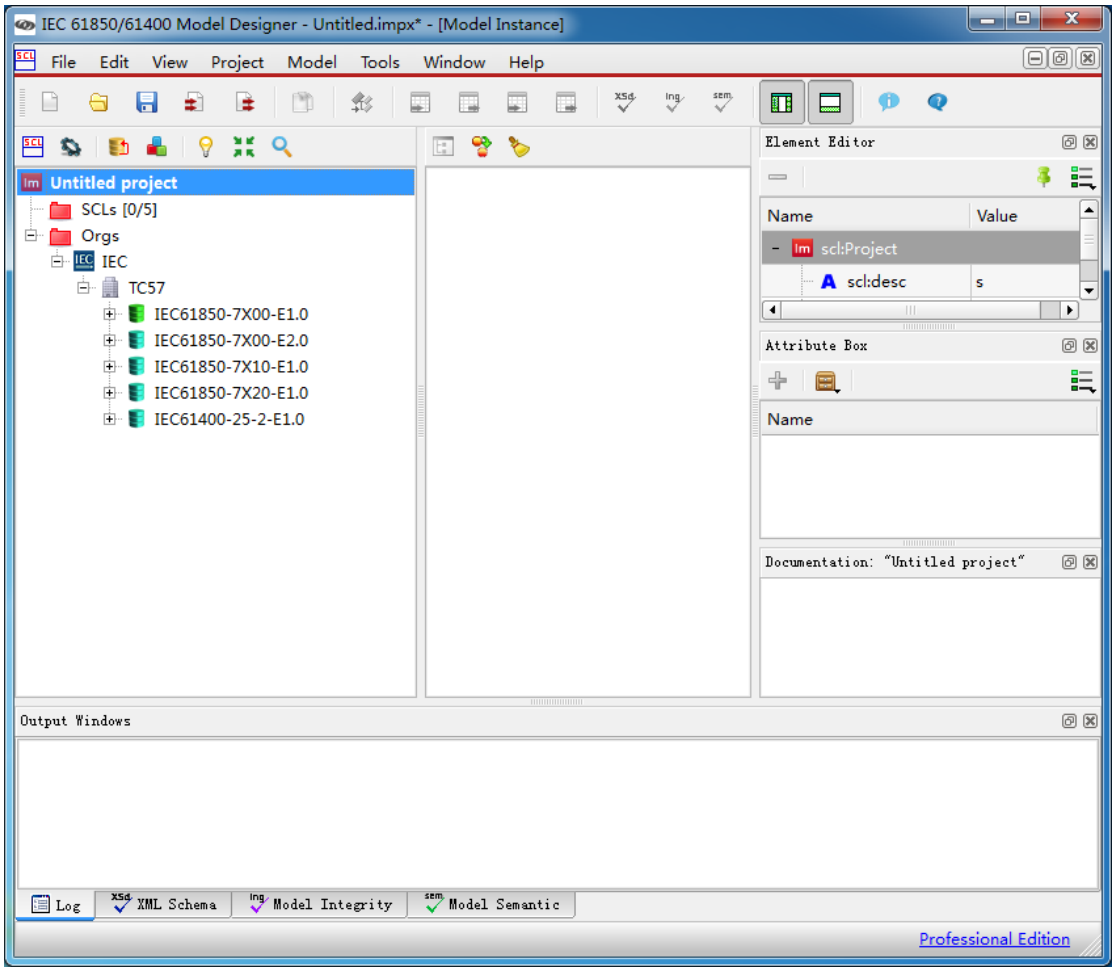


- Step Two

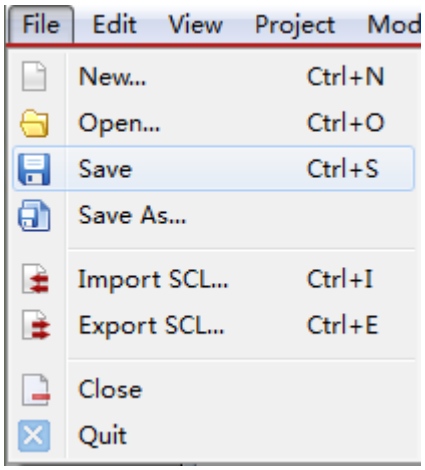


From the **Wizard**, select the **Project Template** and then double click or press the **Create** button on the right. For description detail about the selected **Project**, press **Description>>** button. Five types of **Project Template** are provided in the current release. More will follow in future release to follow the evolution of IEC 61850 and its companion standards.

Once a **Project** is created development can proceed i.e. importation of existing SCLs, creation of new SCL etc., No matter what sort of operations are performed the tool will provide assistance to automate the tasks. Now we have a newly created **Project** named **Untitled**.

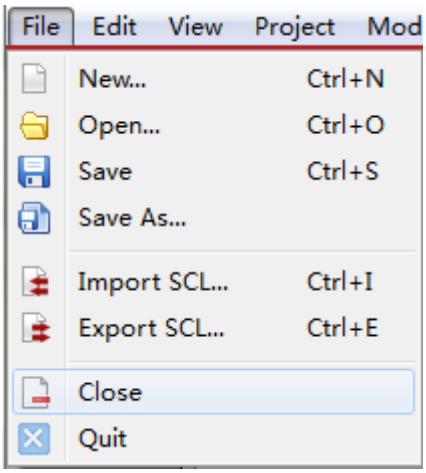


3.5 Save Project



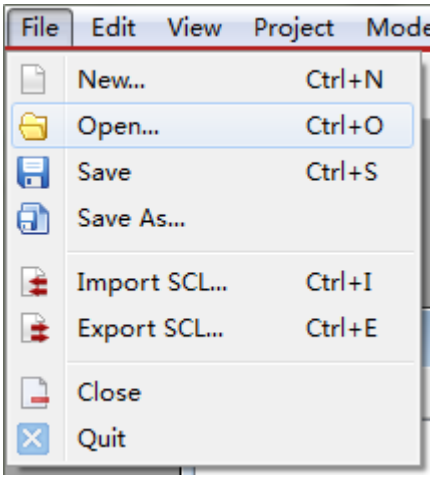
Choose **File-> Save…** and follow the prompted instructions.

3.6 Close Project



Choose **File** ->**Close…**and follow the prompted instructions.

3.7 Open Project



To open an existing **Project**, one of the two approaches may be used:

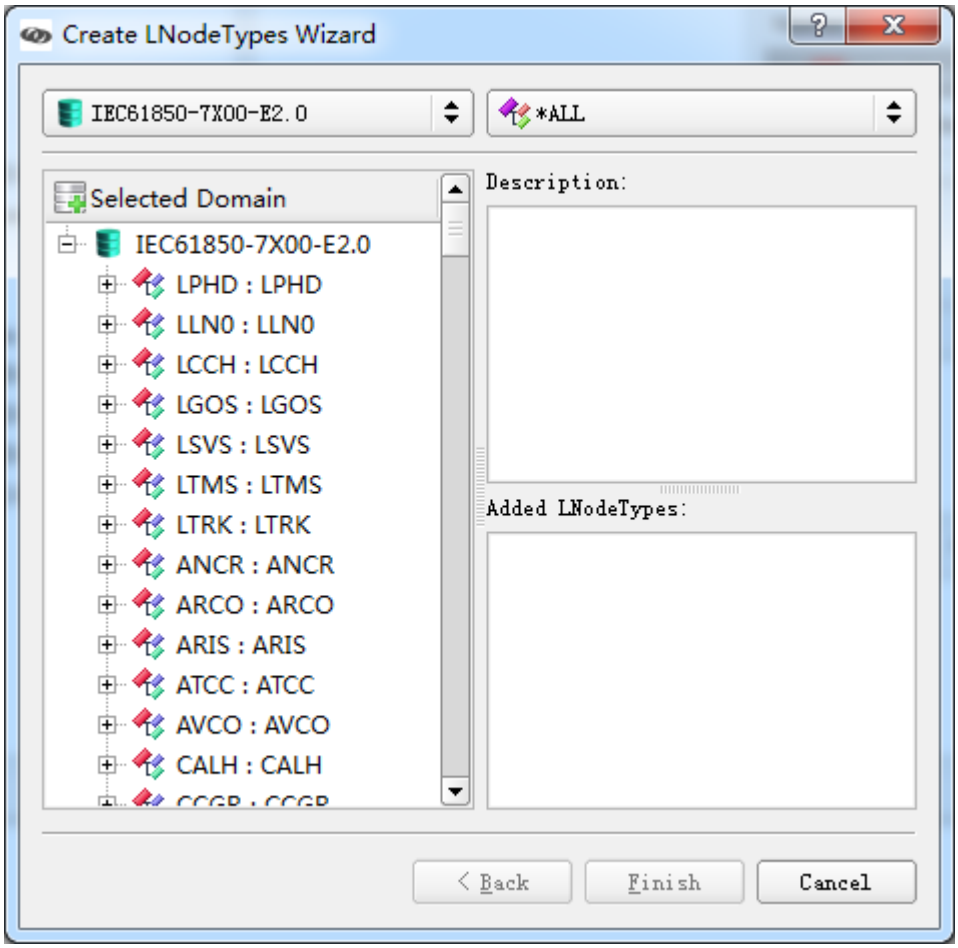
1) Choose **File**-> **Open…** and follow the prompted instructions.

2) **Drag** -**Drop** the **Project** file on the application main window

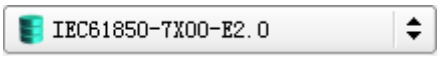
3.8 Create SCL

➢ Step One

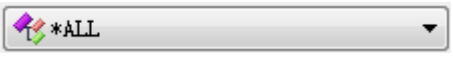
Choose **Project->Create SCL…** or click **Create SCL…** on the toolbar



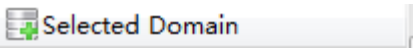
"Create LNodeTypes Wizard" has five parts:

1) Domain drop box 

Choose a **Domain** from which **LNodeTypes** are to be created.

2) Group drop box of LNodeType 

Filter out **LNodeTypes** in accordance to the selected group.

3) Domain tree 

Enumerate **LNodeTypes** of the current selected **Domain**.

4) Object Description Window `Description:`

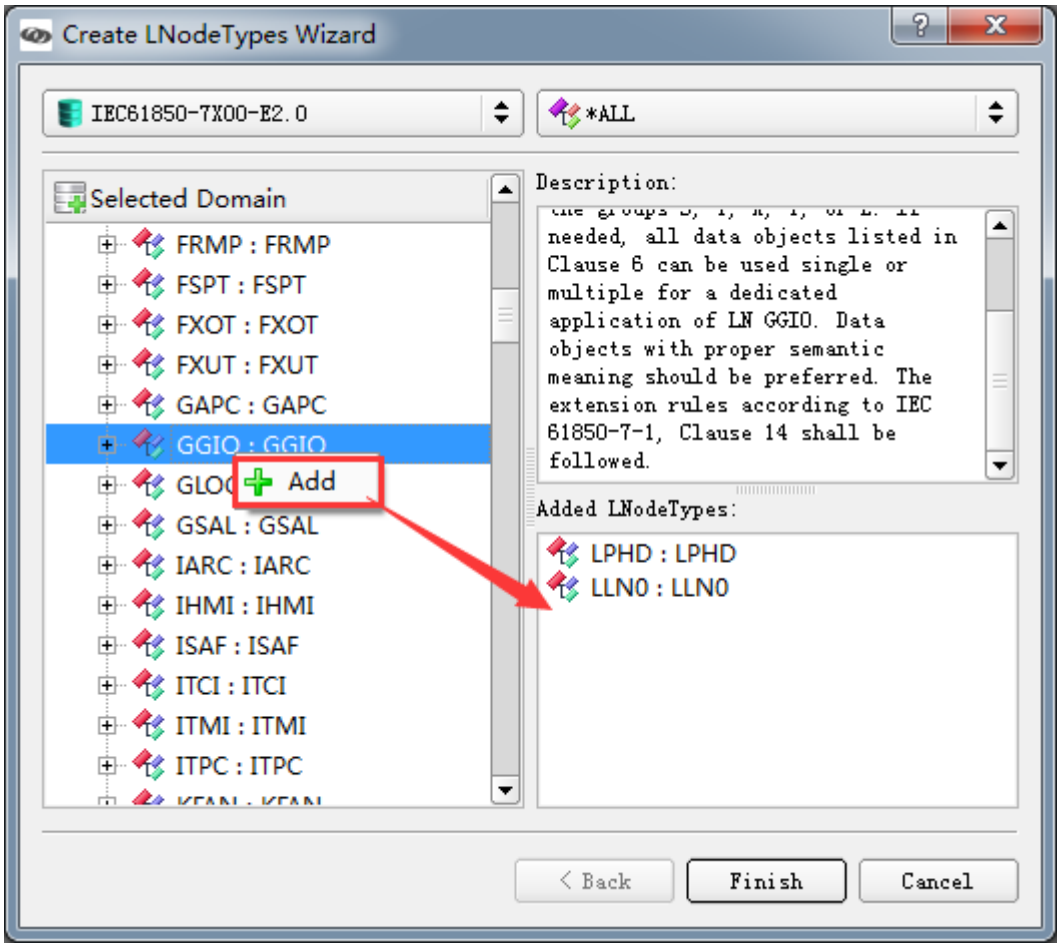
Display description of the current selected object of **Domain tree**, such as **LNodeType**, **DO** etc. This is useful information to learn about model semantics and get instructions on how to use them.

5) Created LNodeTypes List `Added LNodeTypes:`

The newly created **LNodeTypes** are listed in this window.

➢ Step Two

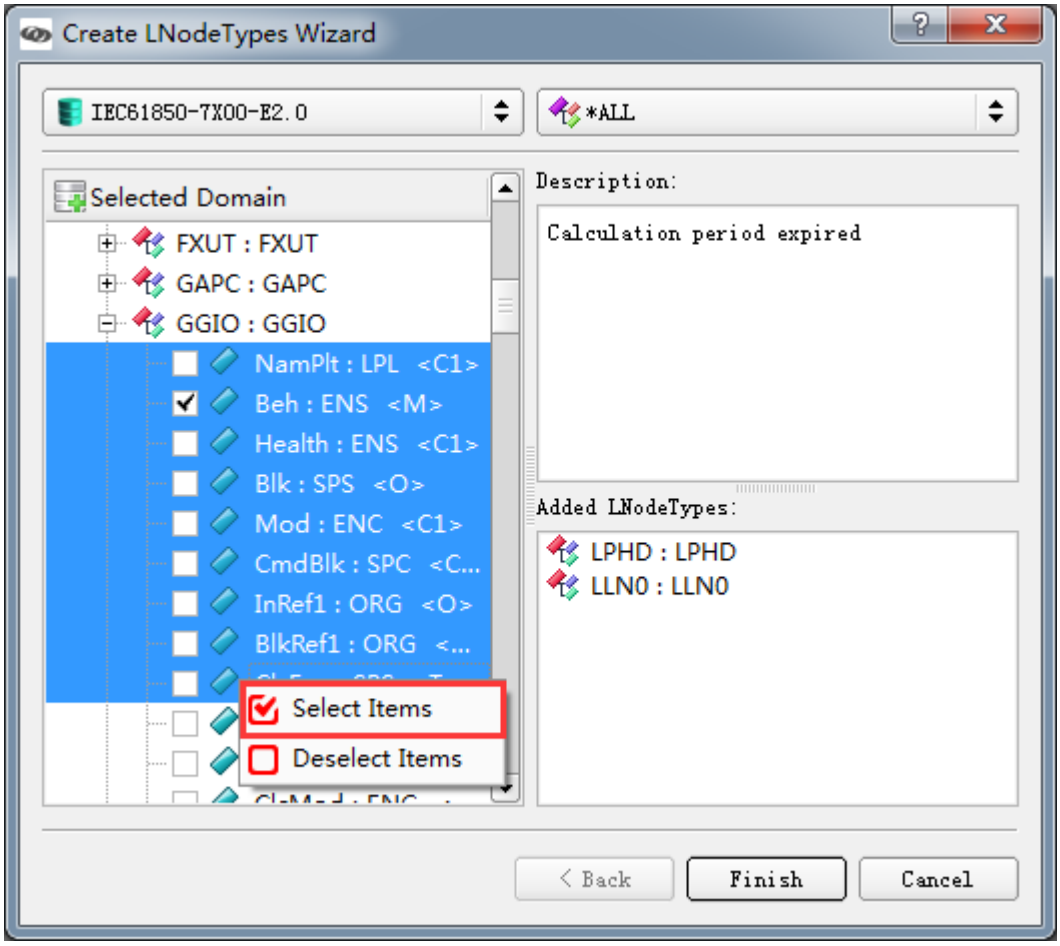
From the **Domain Tree** expand the **LNodeType** of interest; select and check those DOs needed in the model, and then add the **LNodeType** using context menu.



The **Domain Tree** is "**Extended Selection**" enabled:

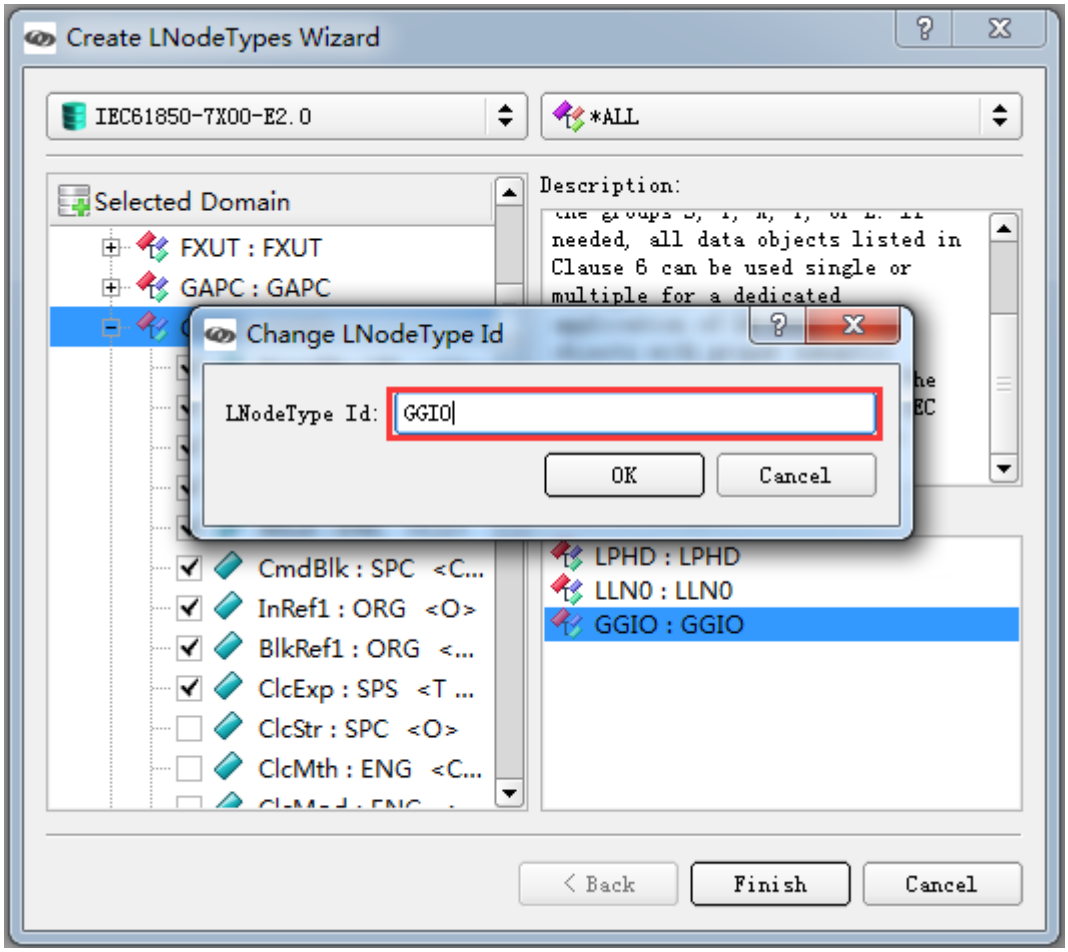
When the user selects a **DO** in the usual way, the selection is cleared and the new **DO** selected.

However, if the user presses the **Ctrl key** when clicking on a **DO**, the clicked **DO** gets toggled and all other **DOs** are left untouched. If the user presses the **Shift key** while clicking on an **DO**, all items between the current **DO** and the clicked **DO** are selected or unselected, depending on the state of the clicked **DO**. Multiple **DOs** can be selected by dragging the mouse over them.

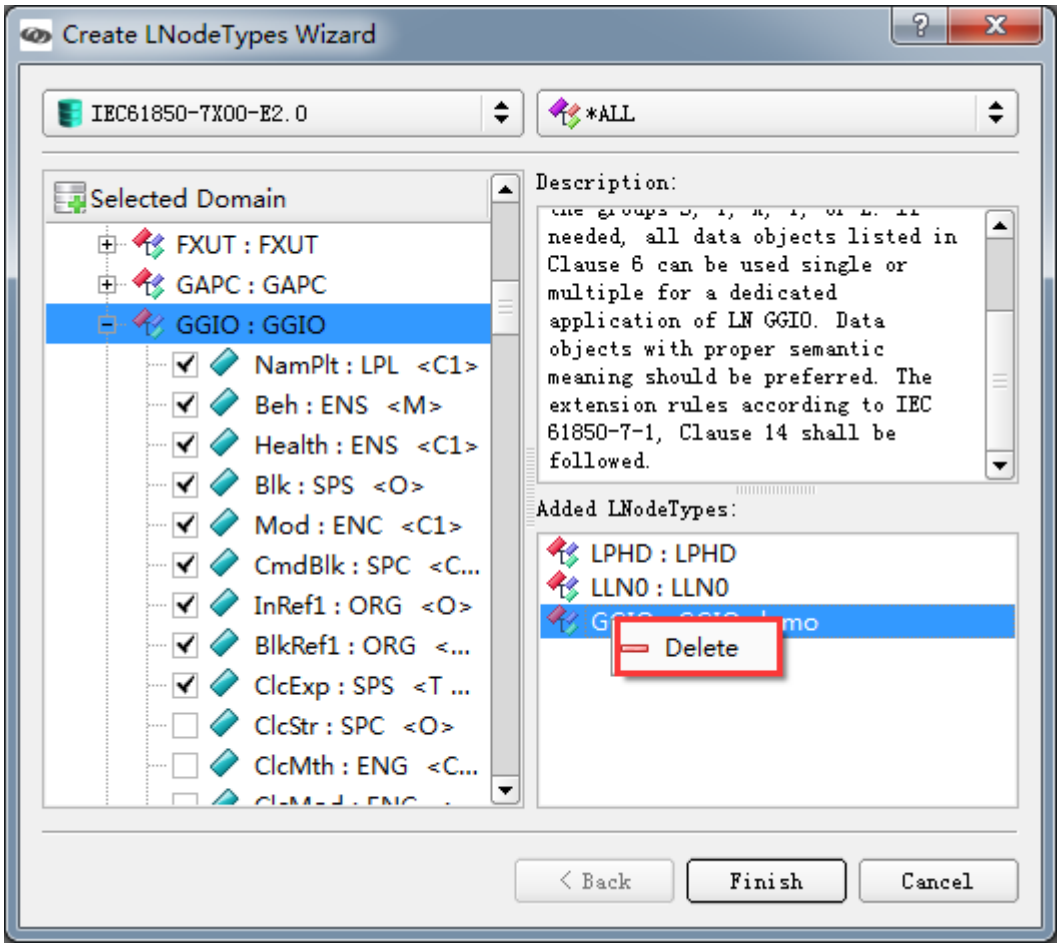


➢ Step Three

For those created **LNodeTypes** within **DataTypeTemplates**, the tool will automatically assign them an unique ID (scl:id); the user can change the ID value by double clicking the **LNodeType**:

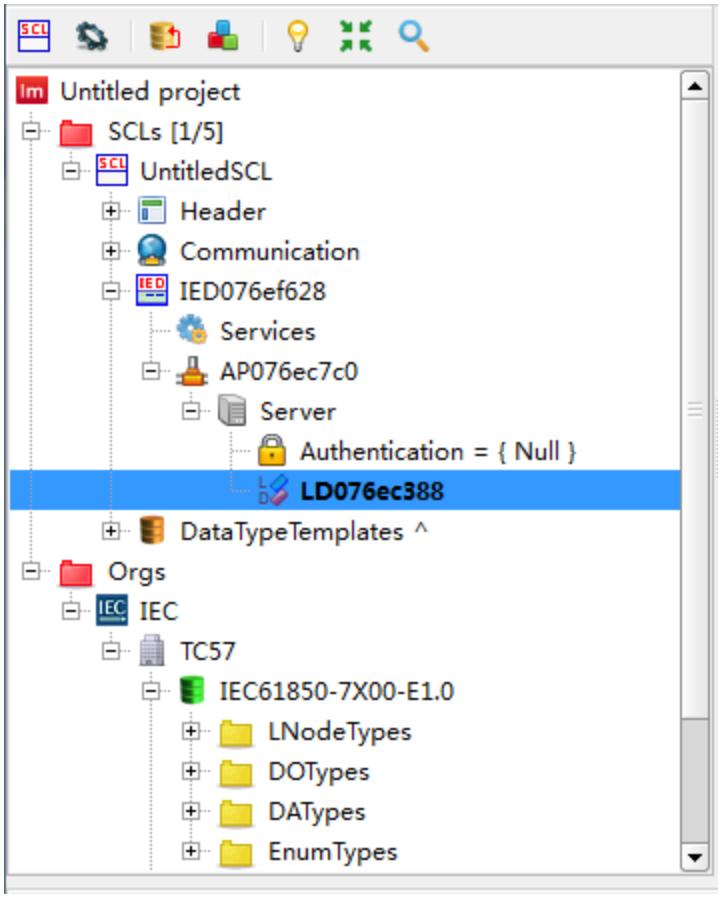


It is also possible to delete the created **LNodeTypes** using the context menu:


Create LNodeTypes Wizard
IEC61850-7X00-E2.0
*ALL
Selected Domain
FXUT : FXUT
GAPC : GAPC
GGIO : GGIO
NamPlt : LPL <C1>
Beh : ENS <M>
Health : ENS <C1>
Blk : SPS <O>
Mod : ENC <C1>
CmdBlk : SPC <C...
InRef1 : ORG <O>
BlkRef1 : ORG <...
ClcExp : SPS <T ...
ClcStr : SPC <O>
ClcMth : ENG <C...
Description:
needed, all data objects listed in Clause 6 can be used single or multiple for a dedicated application of LN GGIO. Data objects with proper semantic meaning should be preferred. The extension rules according to IEC 61850-7-1, Clause 14 shall be followed.
Added LNodeTypes:
LPHD : LPHD
LLN0 : LLN0
Delete
Back
Finish
Cancel

➢ Step Four

When everything is ready click **Finish** to close the wizard. The application will then perform a serial of Element creations which are necessary to a valid SCL, such as Header, Communication, IED as well as their child Elements.

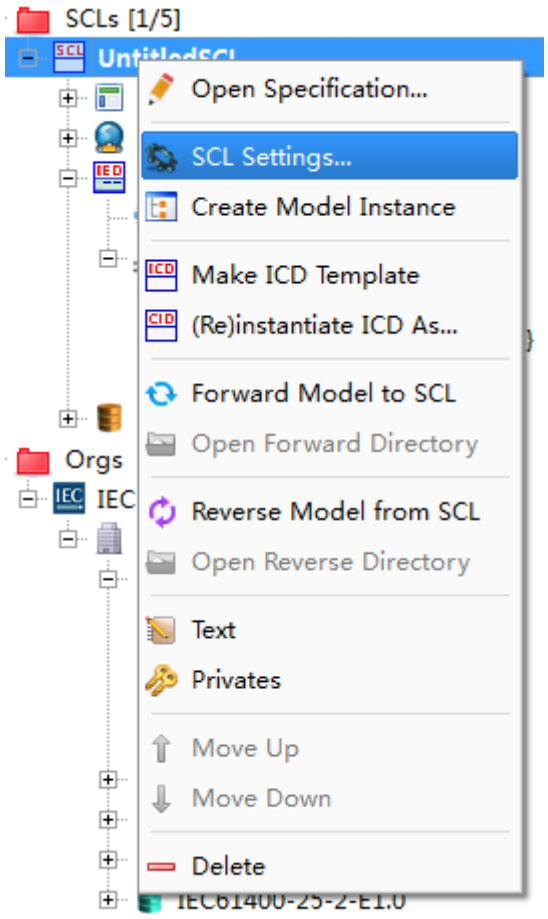


3.9 SCL Settings

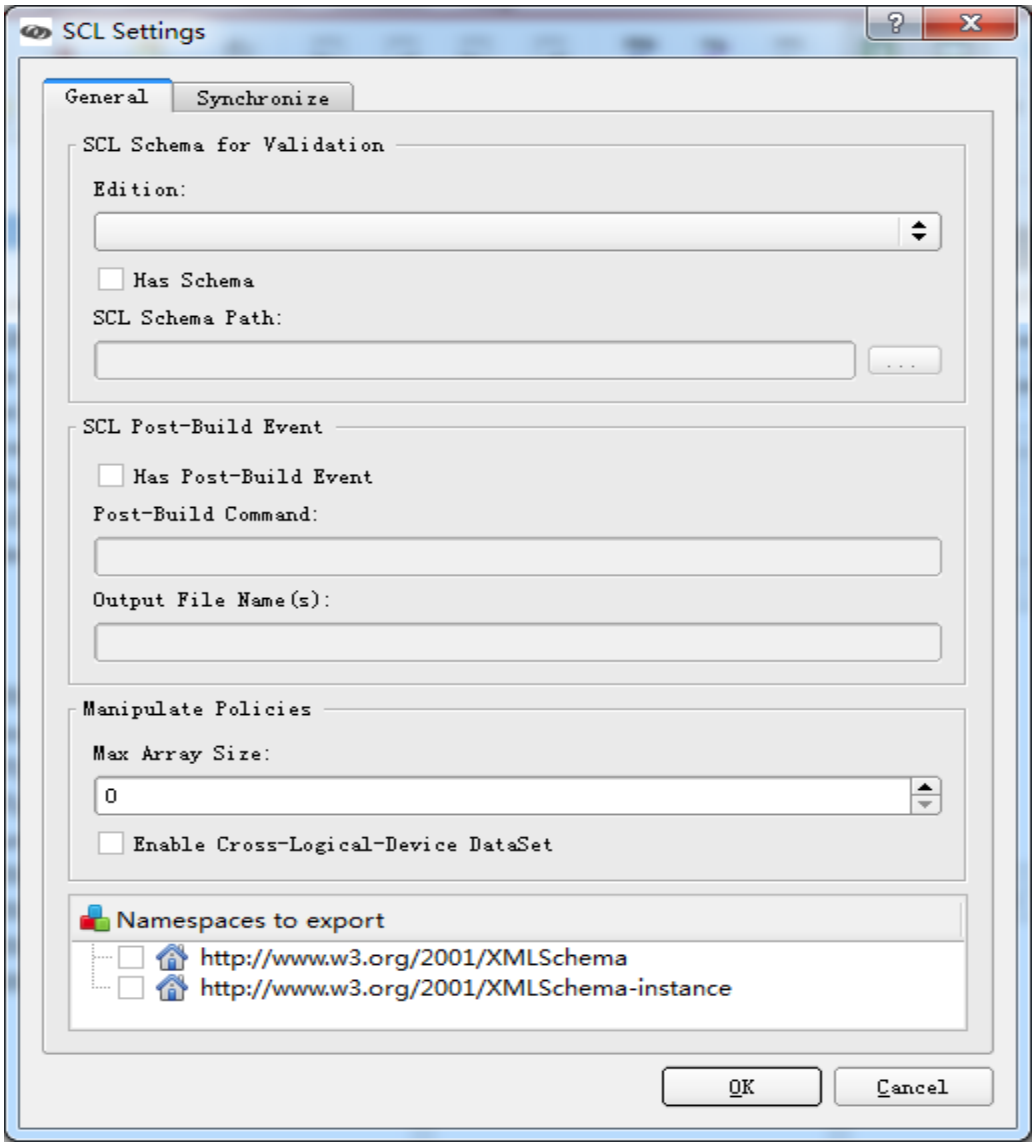
Before working on the newly created **SCL** save the project with a key combination of **Ctrl + s**. **SCL Settings** are important because they affect how the tool behaves.

Use context menu of element **scl:SCL** and choose SCL Settings… :

FUHUA


SCLs [1/5]
Open Specification...
SCL Settings...
Create Model Instance
Make ICD Template
(Re)instantiate ICD As...
Forward Model to SCL
Open Forward Directory
Reverse Model from SCL
Open Reverse Directory
Text
Privates
Move Up
Move Down
Delete
Orgs
IEC

The **SCL Settings** dialog will appear:



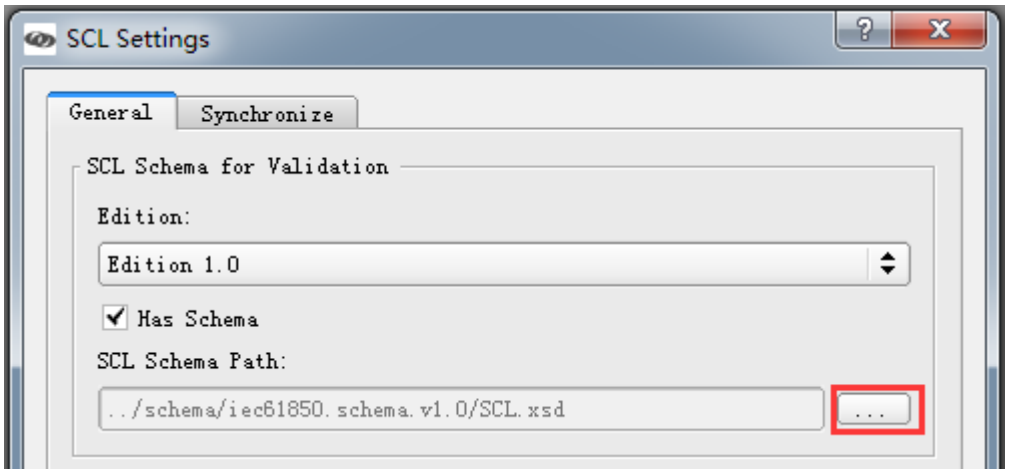
There are two pages (**General**, **Synchronize**) in the **SCL Settings** dialog.

➢ General Page

There are four settings sections in this page:

1) “SCL Schema for Validation” contains settings for XML Schema validation against SCL Schema as specified in IEC 61860-6. The tool supports two major editions of SCL Schema (edition 1.0 and edition 2.0). By default, the tool uses edition 1.0 to check against SCL model, but users can change it manually to edition 2.0 and choose any other SCL Schema variants available in the system.

To use other **SCL Schema** variants, users need to check "**Has Schema**" and choose a valid path to the **SCL Schema** root directory.

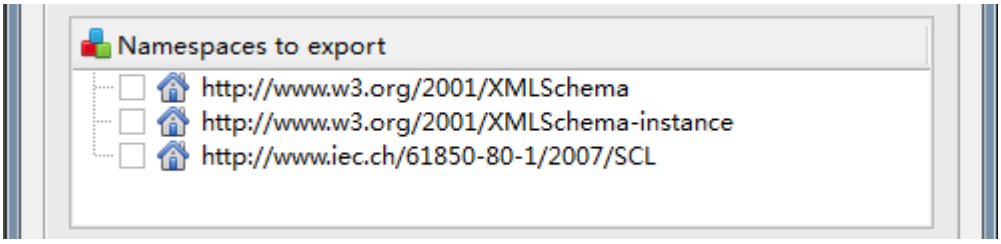


2) "**SCL Post-Build Event**" contains settings for integration with external tools which are qualified to process SCL files. Those external tools are at least able to handle one required input parameter as SCL file name. For example: ***exterltool.exe <agent.cid>***

3) "**Manipulate Policies**" defines how to process **Array Types** and **DataSets**. When **Max Array Size** is set to zero, it implies that the application will ignore **Array Types** processing and treat them as an ordinary **Data Type** (this is the default case for most users). If the value is set greater than ZERO care should be taken as the tool will instantiate all **elements** of the **Array Types** in the SCL model. The **array size** less than 20 is preferred. When **Enable Cross-Logical-Device DataSet** is set, the tool will allow the user to create **DataSets** with data entries distributed within multiple **Logical Devices** of the same **IED**. It is not receommended to create **DataSets** in this way but the tool will support the feature.

4) "Namespaces to export" acts as filters. Only those checked Namespaces are allow to export their

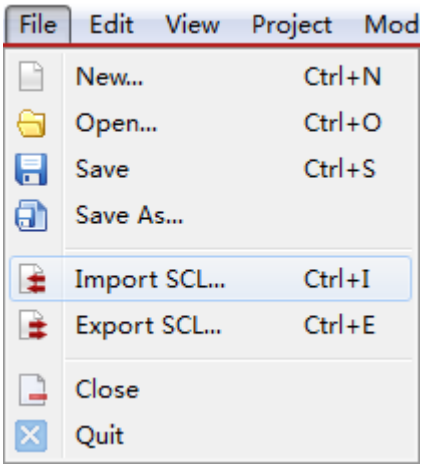
Elements along with target Namespace. This feature is useful when users have defined Private Namespaces (for more details see other chapters in this manual) for model extension, such as Data Mapping, Logic Definition etc.



3.10 Import SCL

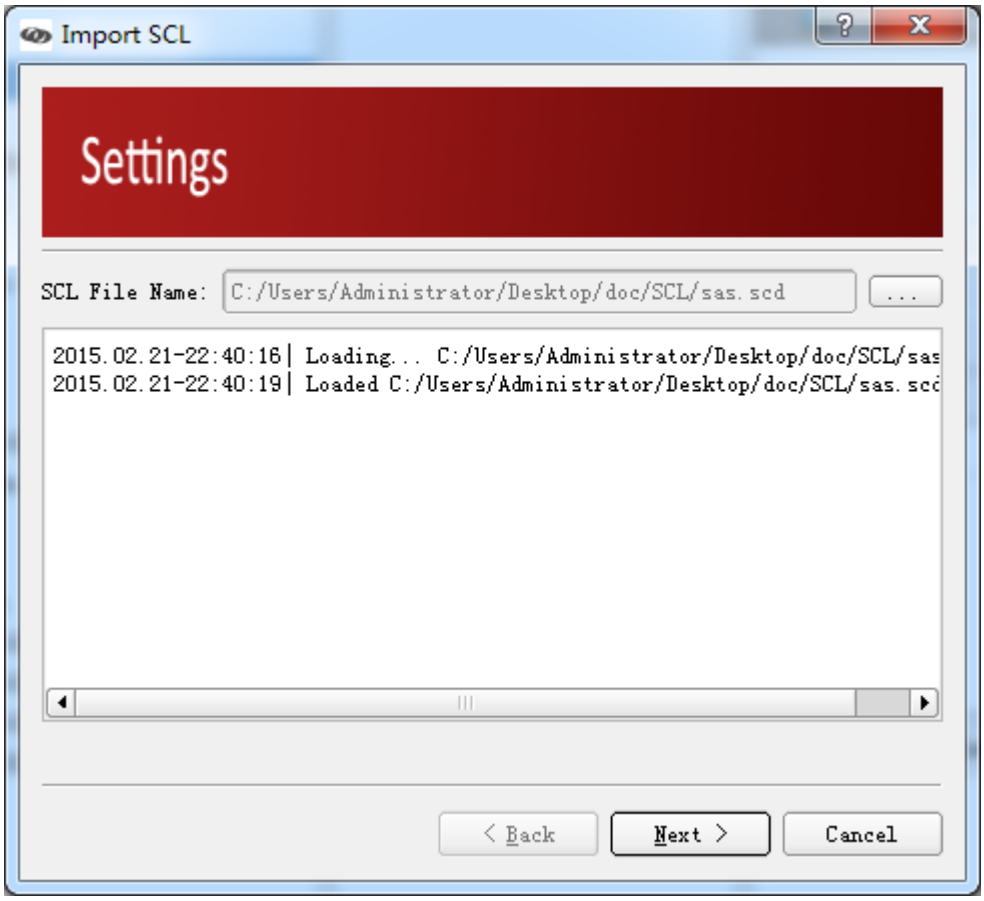
SCL importation can be considered as ICD/CID/IID extraction from an SCL file (such as SCD). The importation will ignore **Data Types** which are unused within the **SCL** model; in consequence the model will always remain compact, clean and efficient.

Choose **File-> Import SCL…**or click **Import SCL** on the toolbar. You can also **Drag-Drop** the **SCL** file onto the main window to trigger the importation.



- Step One

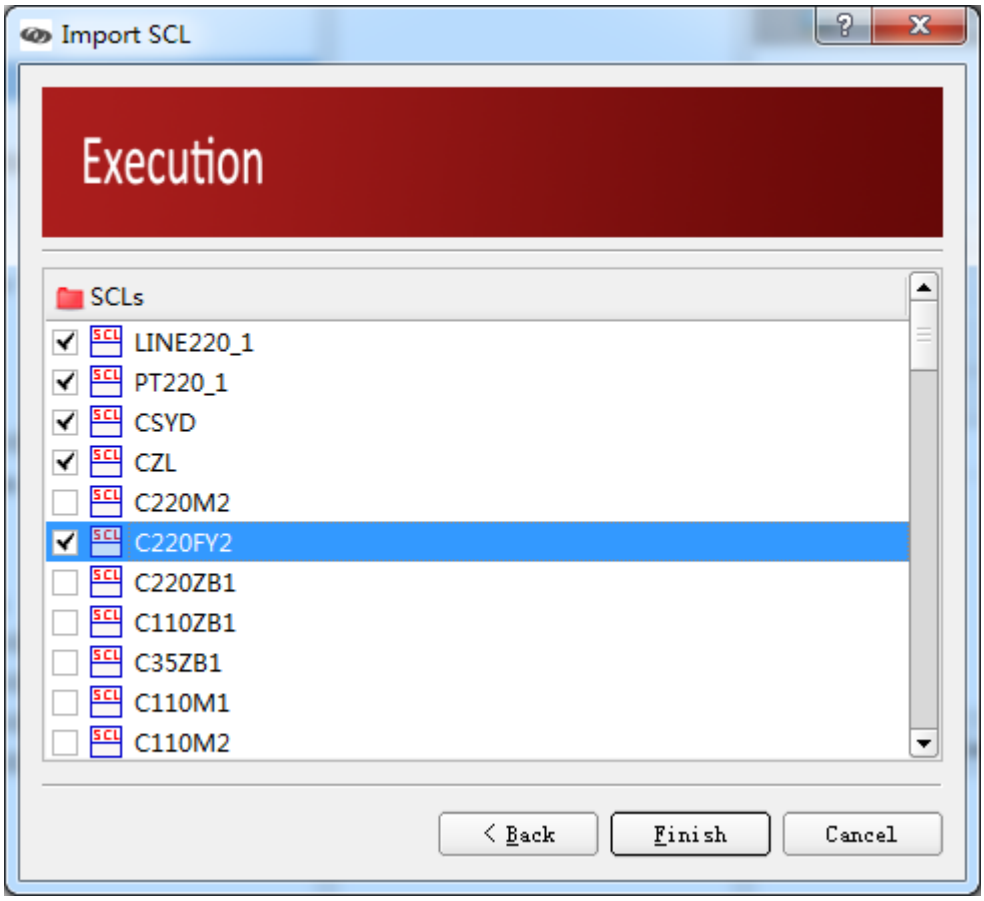
Load SCL file…



If no error messages are reported then proceed to **Step Two**;

➢ Step Two

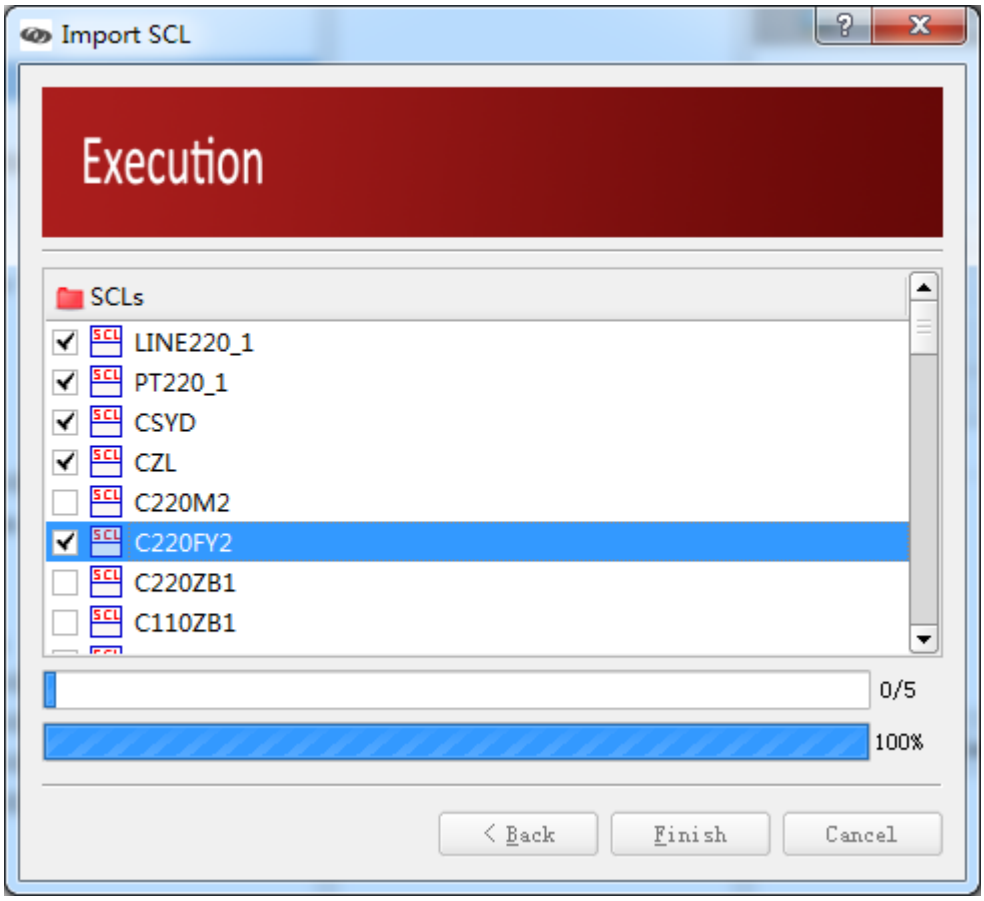
Click **Next** and select the IED(s) to be imported.



Note: Only five SCLs can be created within one project. If you select more than five IEDs, it will ignore the latter ones.

➢ Step Three

Click **Finish** and wait for termination.

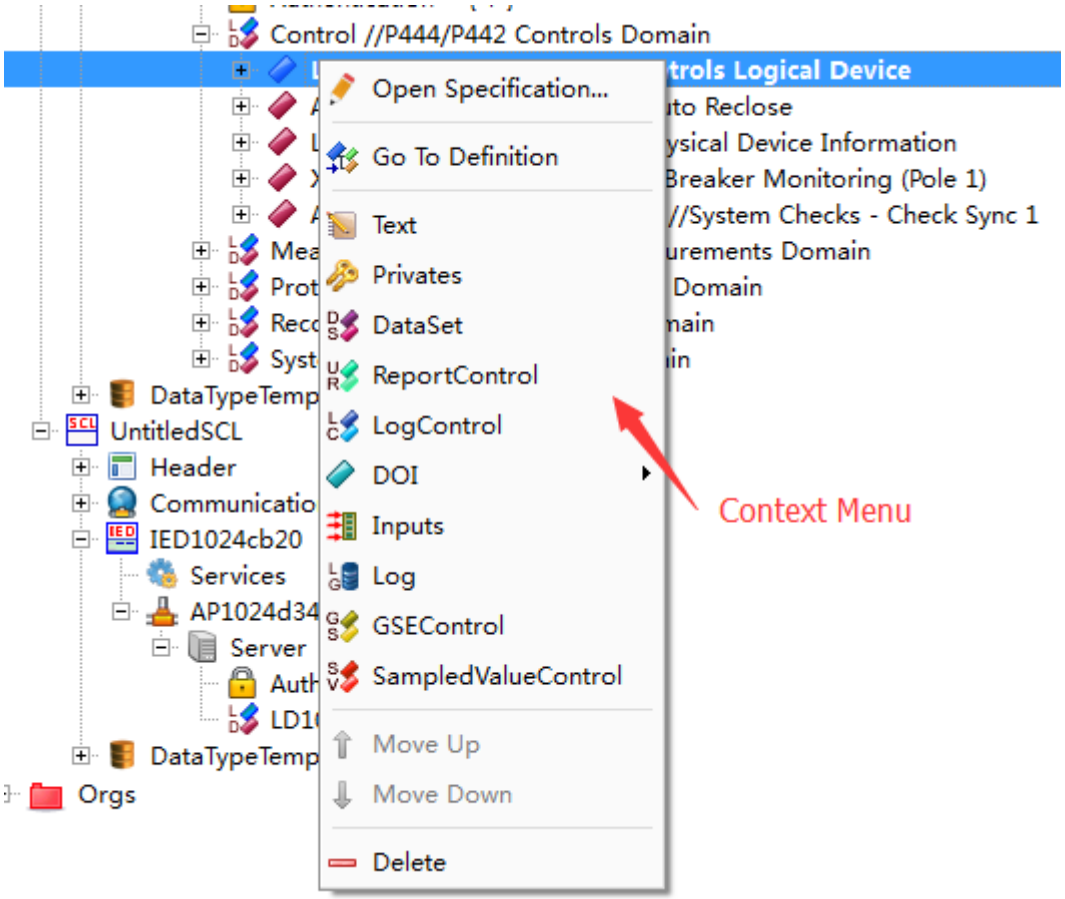

Import SCL
Execution
SCLs
LINE220_1
PT220_1
CSYD
CZL
C220M2
C220FY2
C220ZB1
C110ZB1
0/5
100%
< Back
Finish
Cancel

3.11 SCL Manipulation

SCL Manipulation makes use of the tool's **Event Propagation Engine**. This event engine is powerful; users don't have to worry about breaking IEC 61850-6 rules. The tool will propagate the operations that users make and correct any errors introduced.

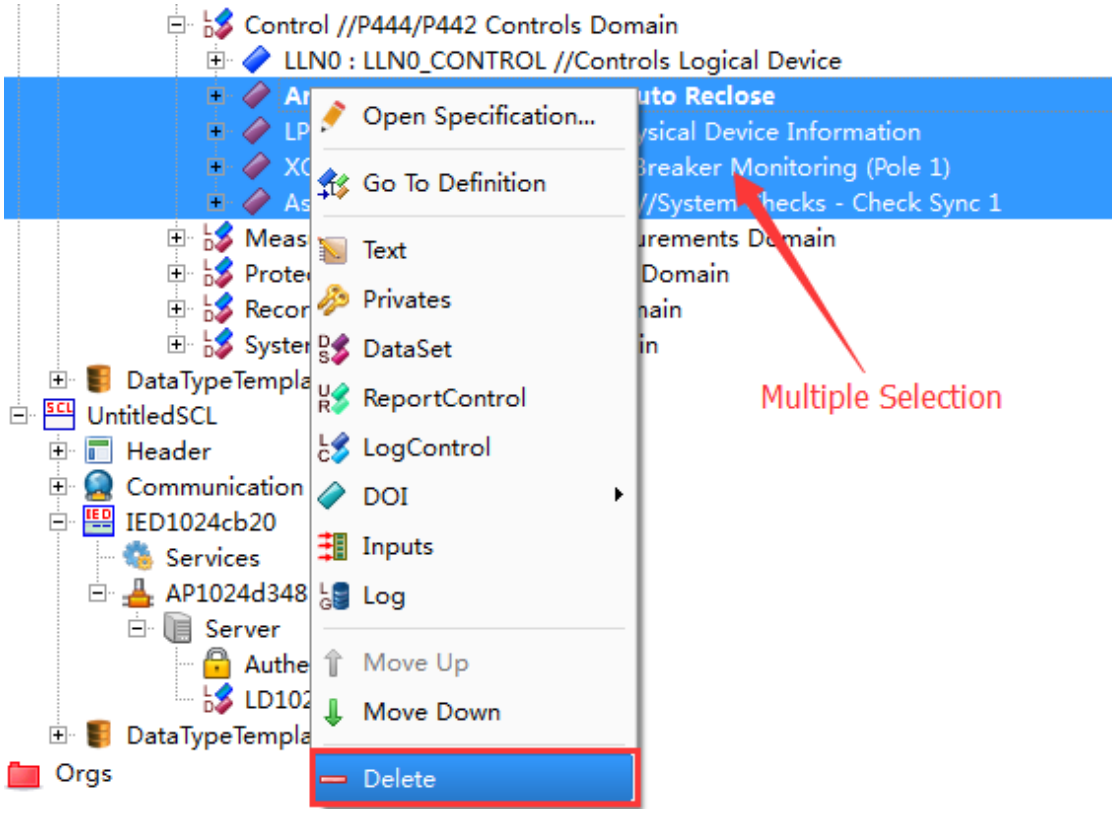
3.11.1. Create Element

Any Element to create is based on context menu or wizard dialog.

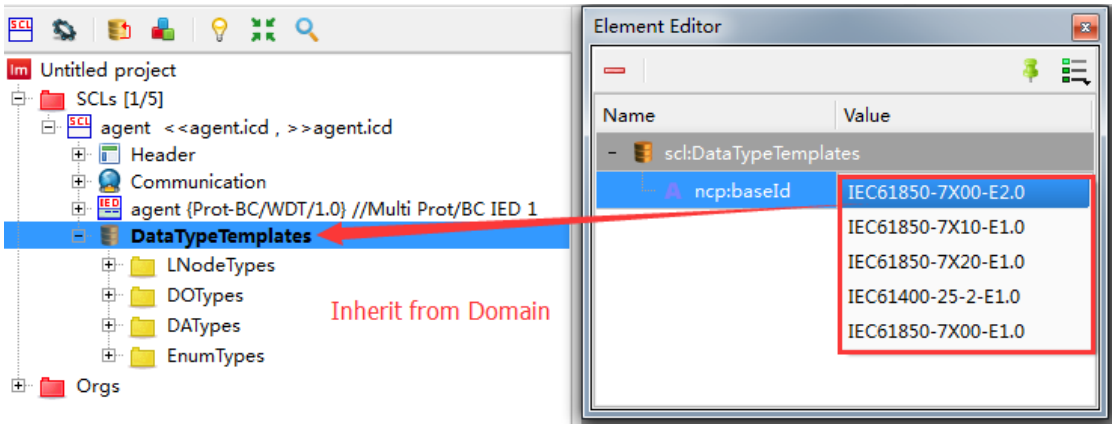


3.11.2. Delete Element

All Elements are deleted using a context menu. Multiple Elements deletion is supported by "Extended Selection".

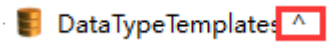


3.11.3. DataTypeTemplates Manipulation



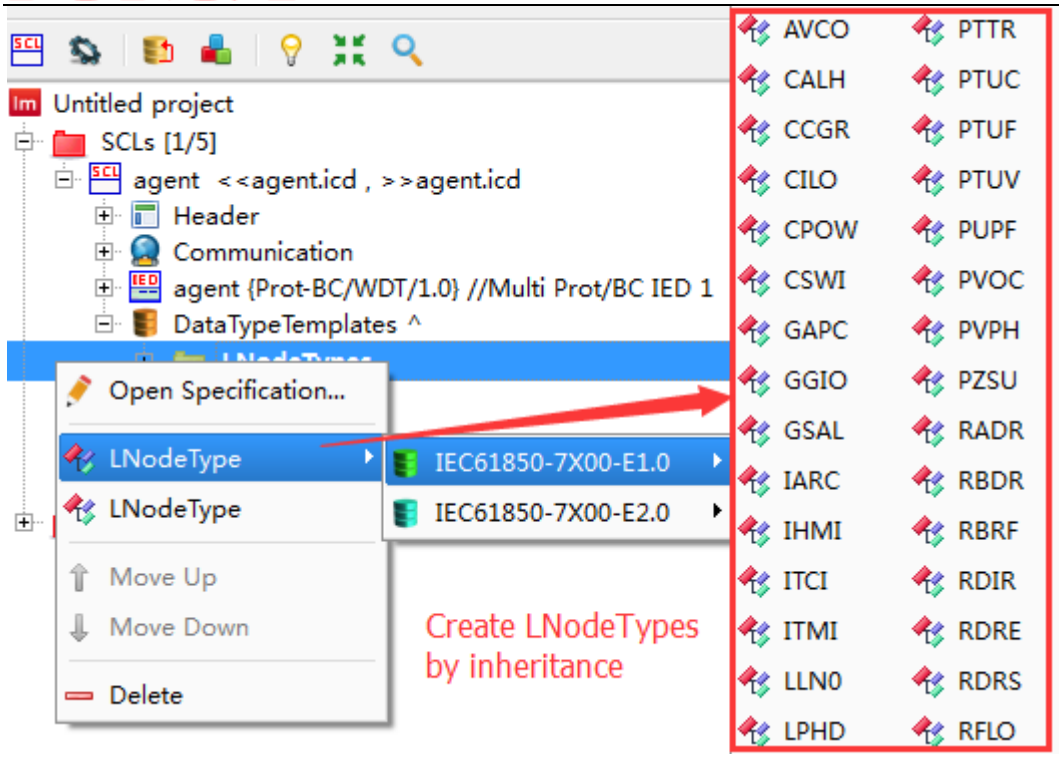
An important feature of the tool is **Inheritance**. All **Data Types** within **Domain** or **DataTypeTemplates** are inheritable. **Domain** itself can also be inherited. **Inheritance** can make **Data Types** creation very easy, because it is possible to reuse those **Data** already defined in **Base Types**. **Inheritance** also makes backward compatibility possible and keeps track of developments in IEC 61850/61400. The picture above is about **DataTypeTemplates** which inherits **Domain IEC61850-7X00-V2.0, IEC61850-7X00-V2.0** which itself is derived from **Domain IEC61850-7X00-V1.0** (A root **Domain** inherited by any other **Domains**).

Note: If **DataTypeTemplates** inherits any **Domains**, a '^' sign will appear alongside.



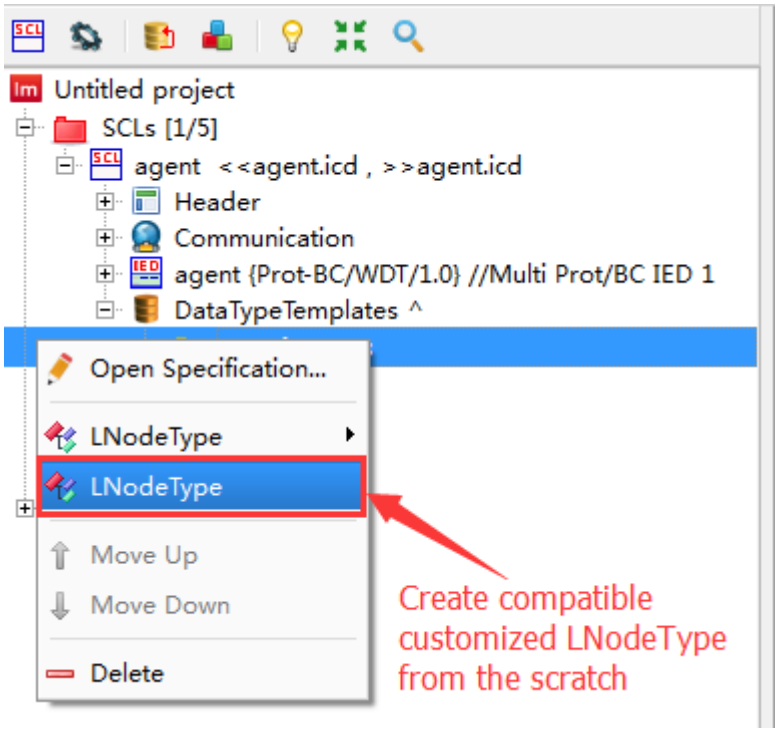
3.11.3.1. LNodeType Manipulation

- Create LNodeTypes by Inheritance



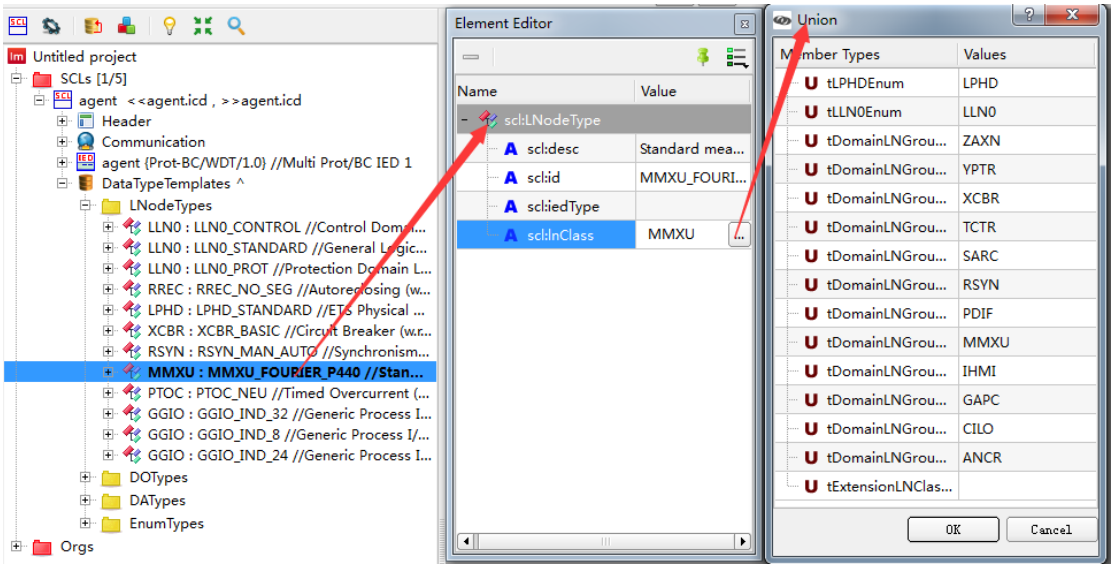
Fellow the context menu, choose the **LNodeTypes** from the **Dropboxes**.

- Create customized **LNodeTypes**



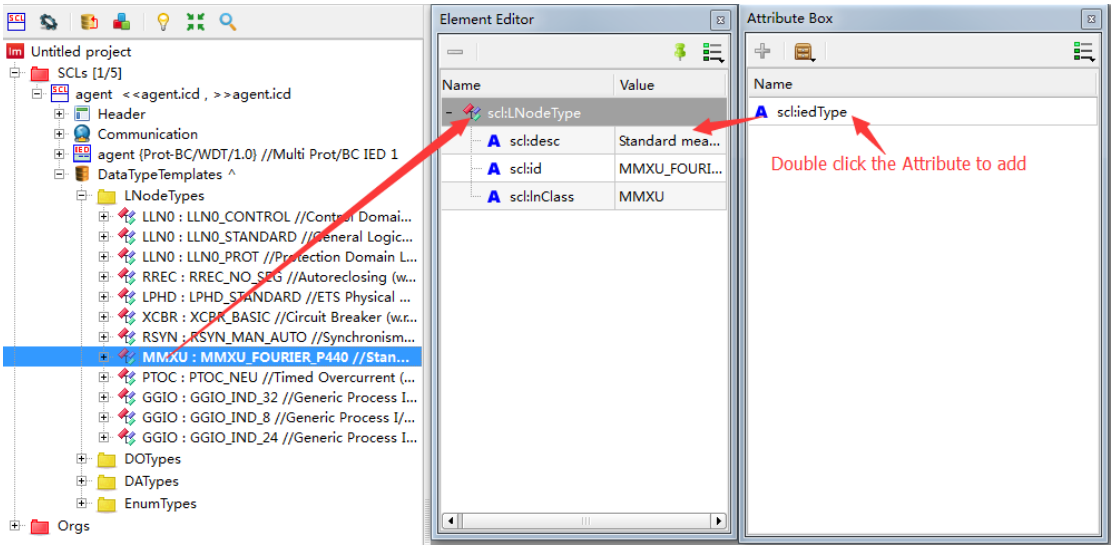
If all **LNodeTypes** from standard Domains do not meet user requirements then users can customize compatible **LNodeTypes** of their own.

➢ Edit **LNodeTypes**



Change the **LNodeType** attributes using **Element Editor.**

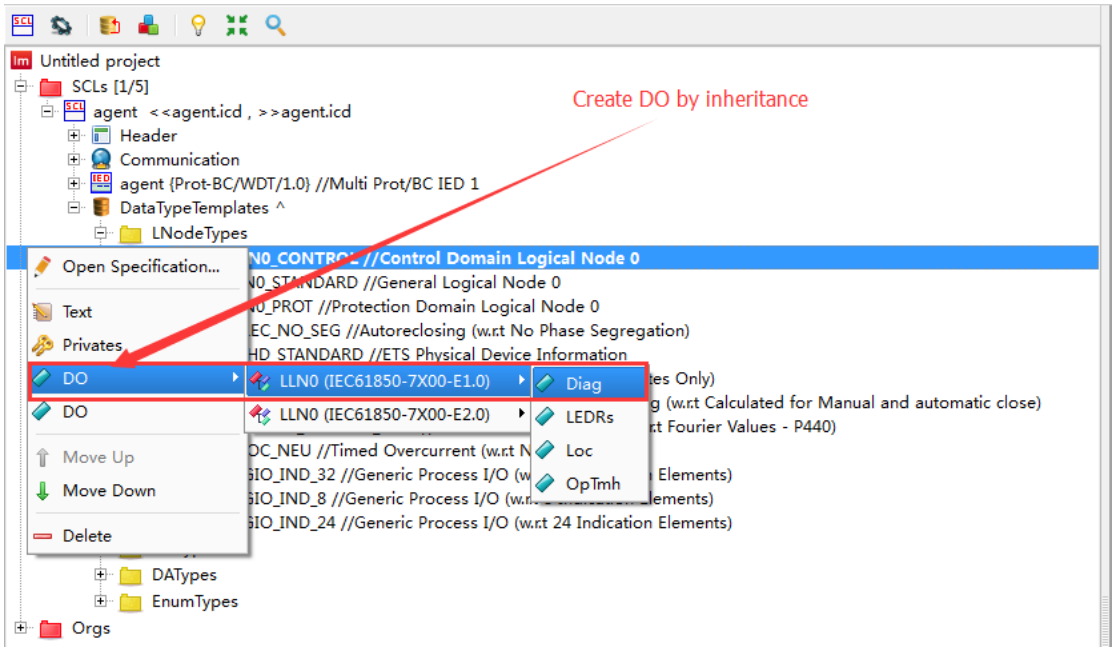
➢ Add optional **Attributes**



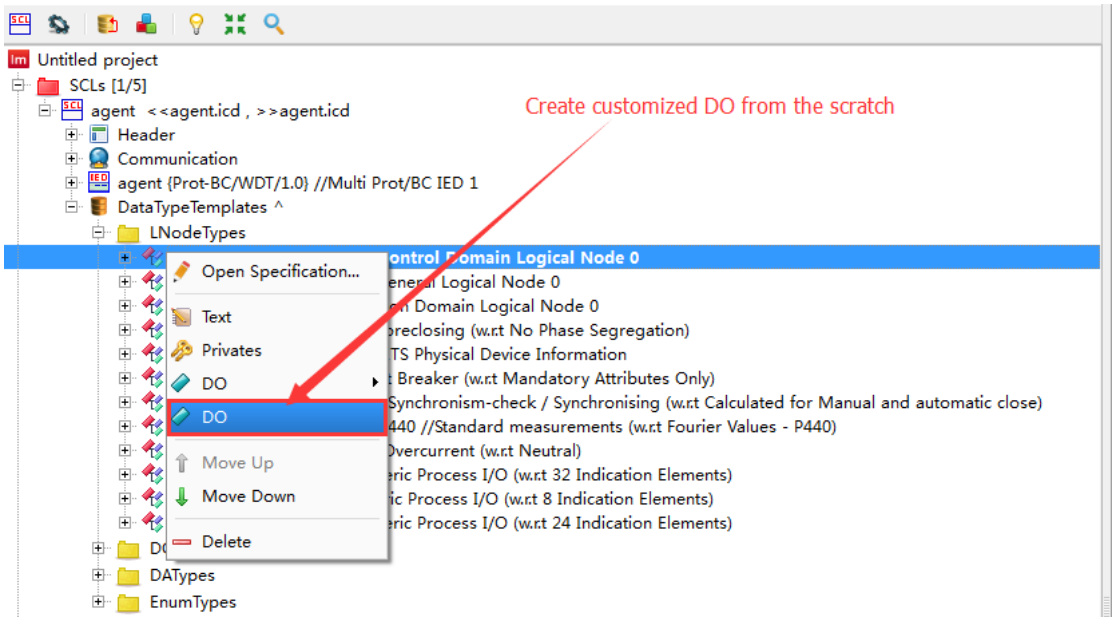
By default, each newly created **Element** is only equipped with the required **Attributes**; optional **Attributes** should be added manually by users as required.

3.11.3.2. DO Manipulation

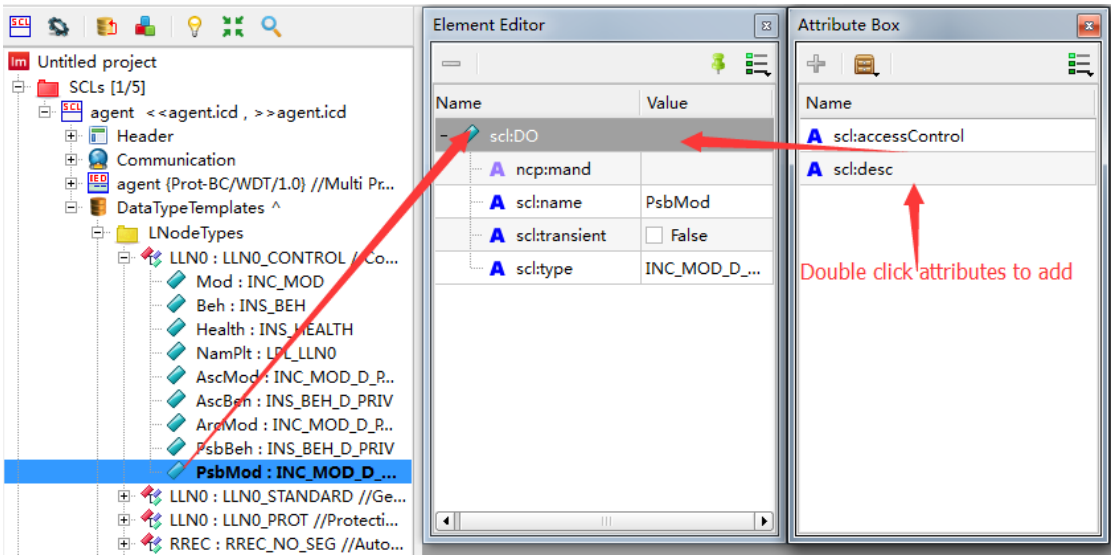
- Create **DOs** by Inheritance



- Create customized **DOs**

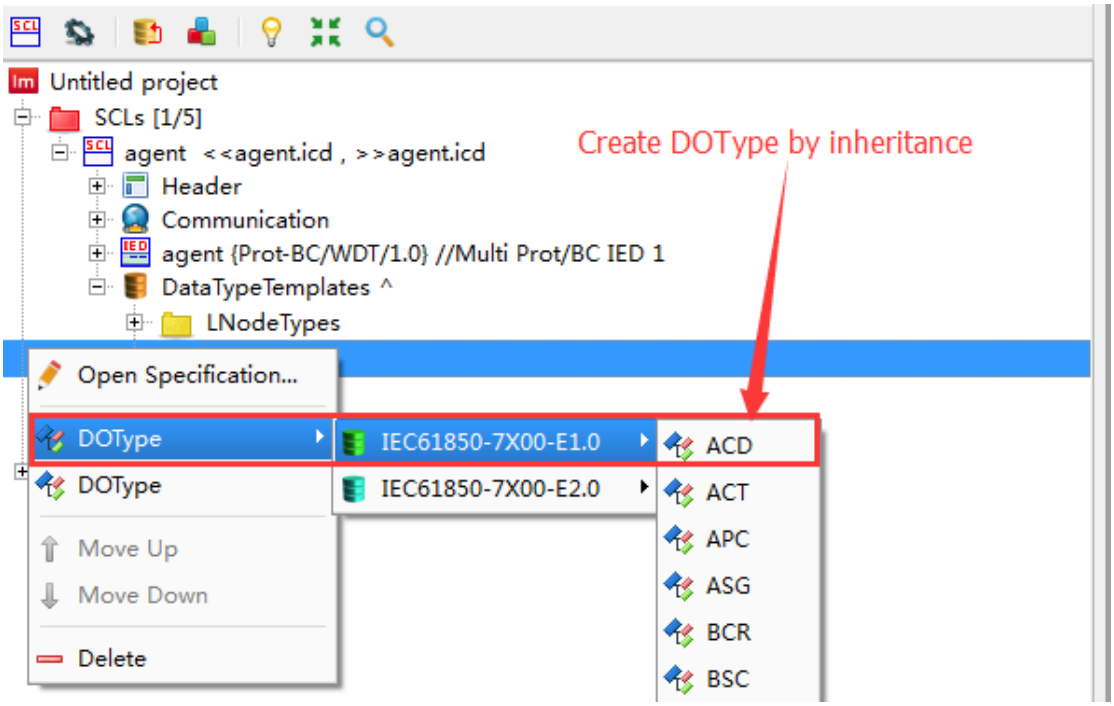


➢ Add optional **Attributes**

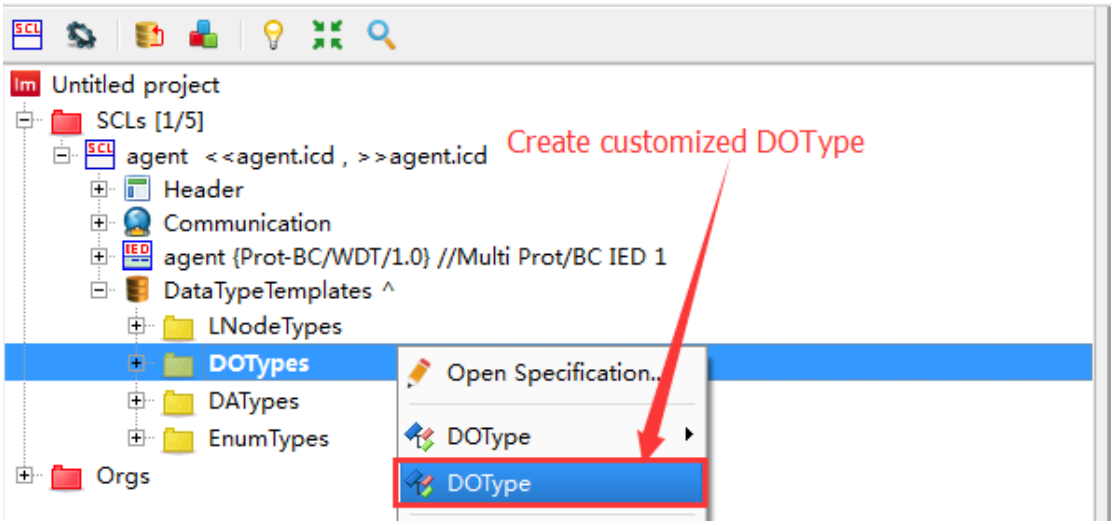


3.11.3.3. DOType Manipulation

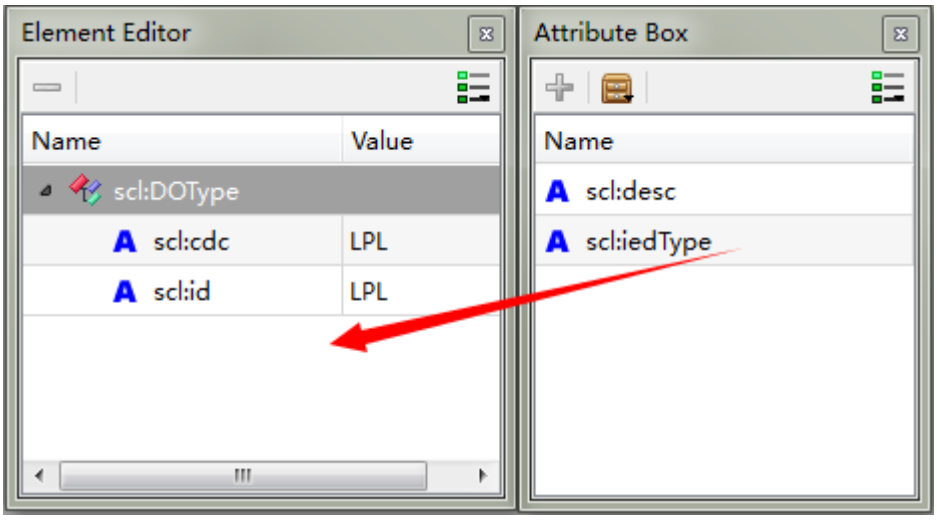
➢ Create **DOTypes** by Inheritance



- Create customized **DOTypes**

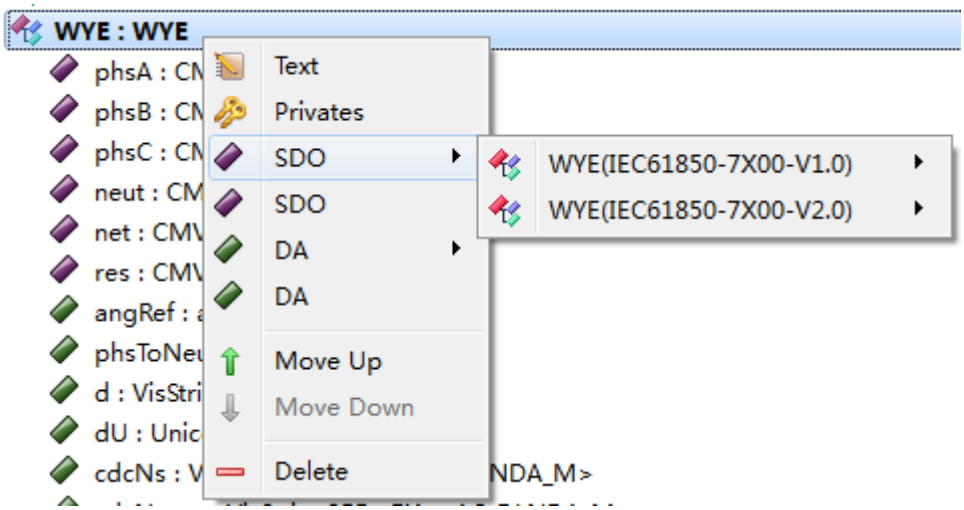


- Add optional **Attributes**

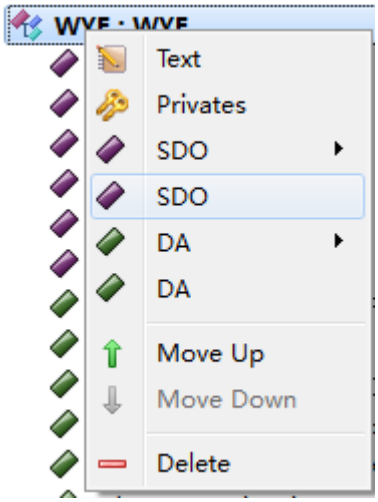


3.11.3.4. SDO Manipulation

- Create **SDOs** by Inheritance

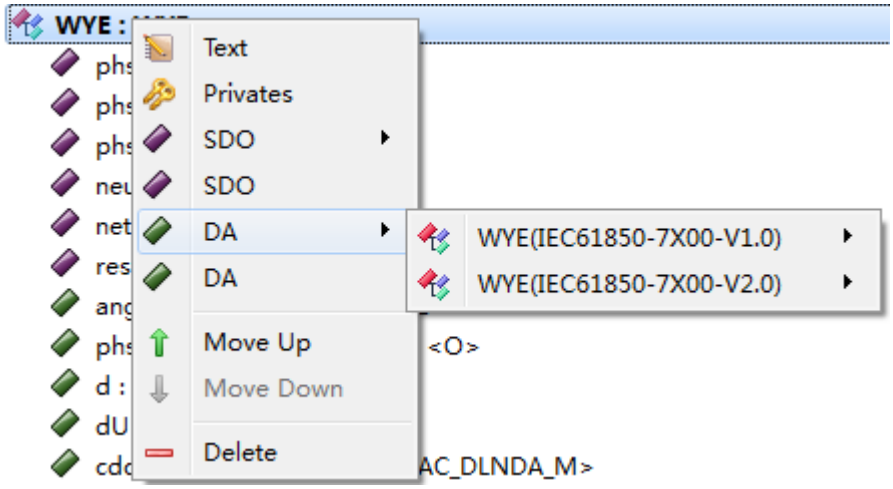


- Create customized **SDOs**



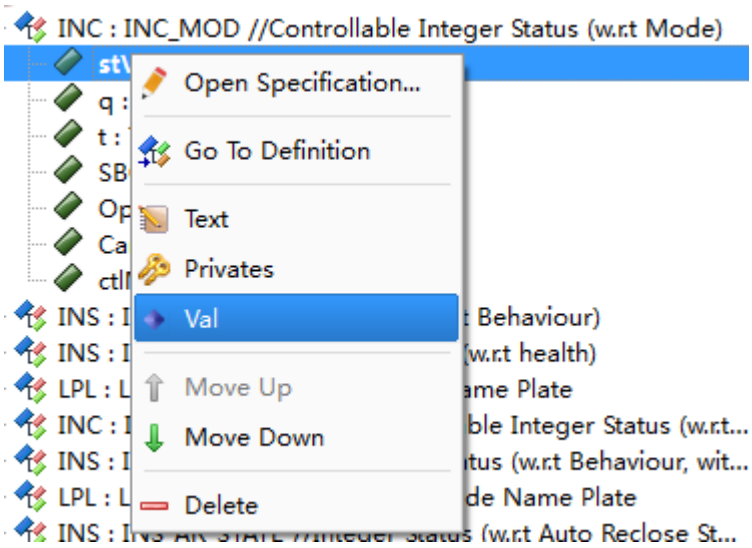
3.11.3.5. DA Manipulation

- Create **DAs** by Inheritance

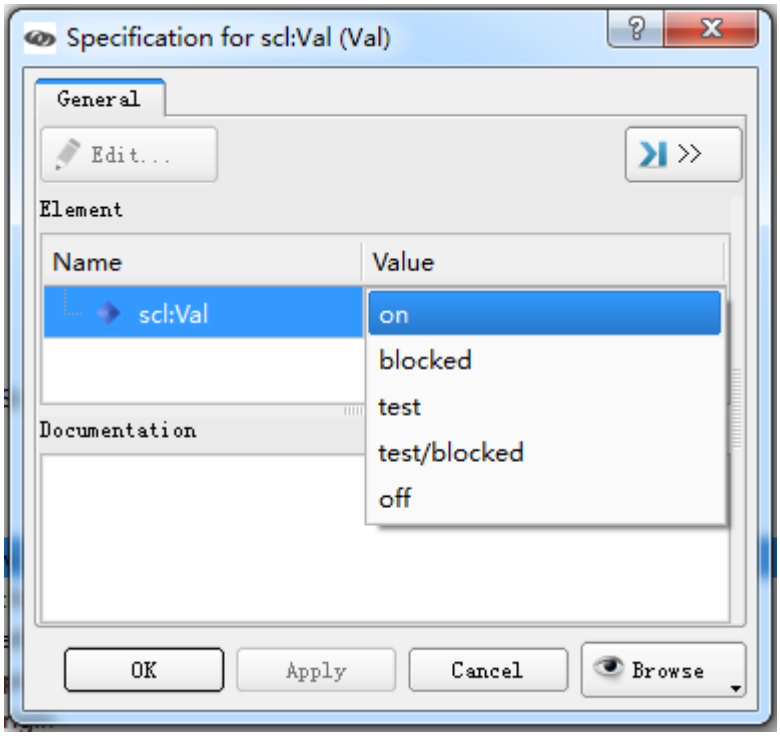


- Create customized **DAs**

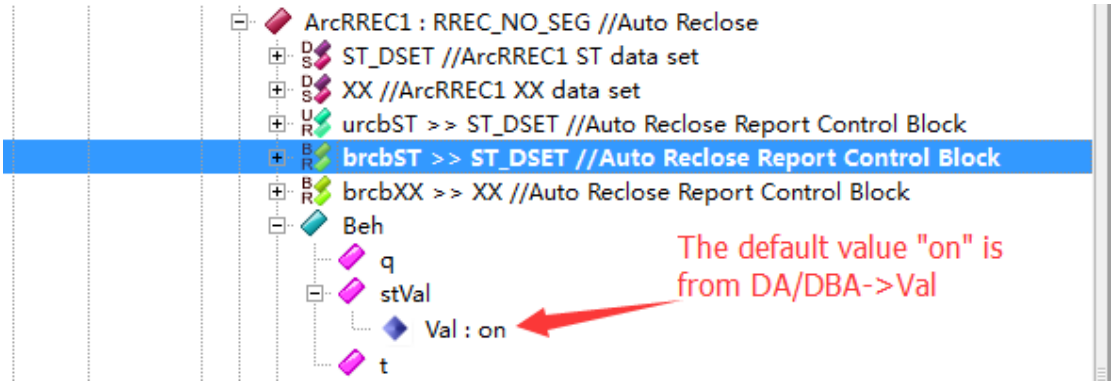
- Create DA default Value



From context menu click "**Val**"



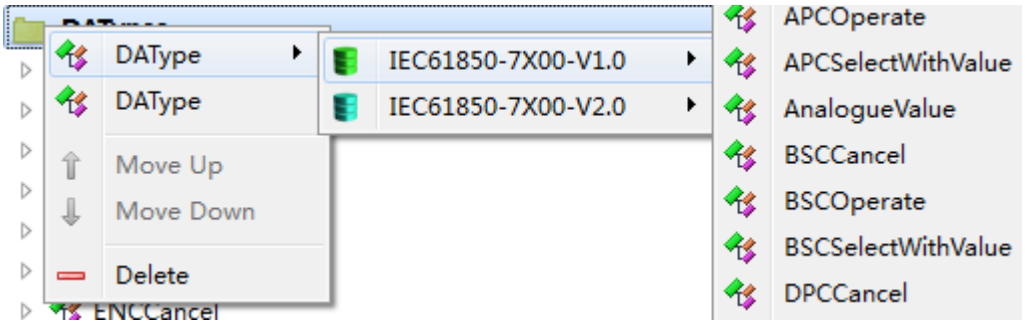
Assign **Val** a default Value.


ArcRREC1 : RREC_NO_SEG //Auto Reclose
ST_DSET //ArcRREC1 ST data set
XX //ArcRREC1 XX data set
urcbST >> ST_DSET //Auto Reclose Report Control Block
brcbST >> ST_DSET //Auto Reclose Report Control Block
brcbXX >> XX //Auto Reclose Report Control Block
Beh
q
stVal
Val : on
t
The default value "on" is from DA/DBA->Val

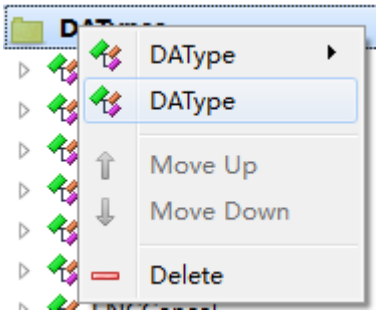
Note: Default values can be very useful when **DOI->SDI/DAI->Val** is instantiated to have a default value as described by the picture above.

3.11.3.6. DAType Manipulation

- Create **DATypes** by Inheritance

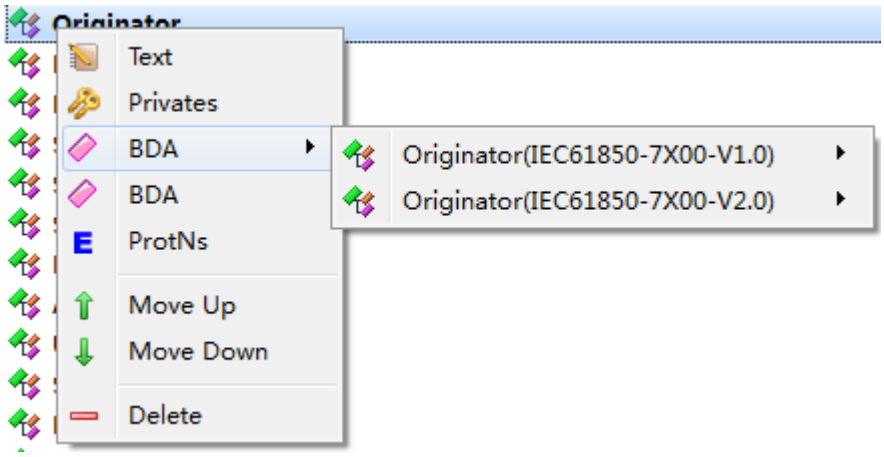


- Create customized **DATypes**

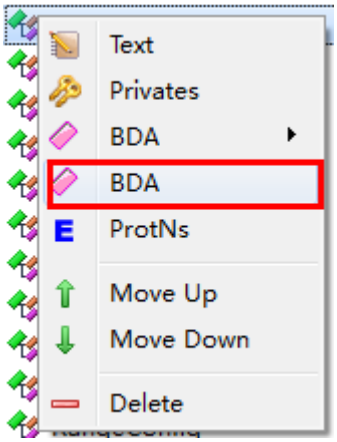


3.11.3.7. BDA Manipulation

- Create **BDAs** by Inheritance



- Create customized **BDAs**

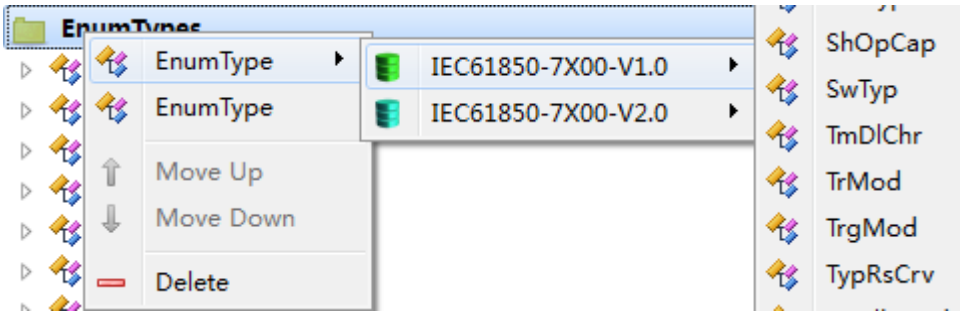


- Create DBA default Value

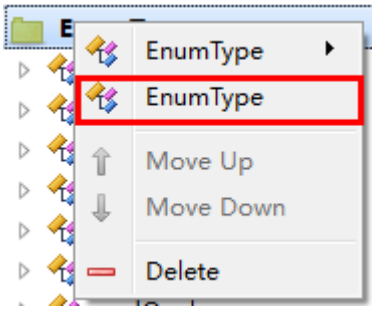
The same as **DA**.

3.11.3.8. EnumType Manipulation

- Create **EnumTypes** by Inheritance

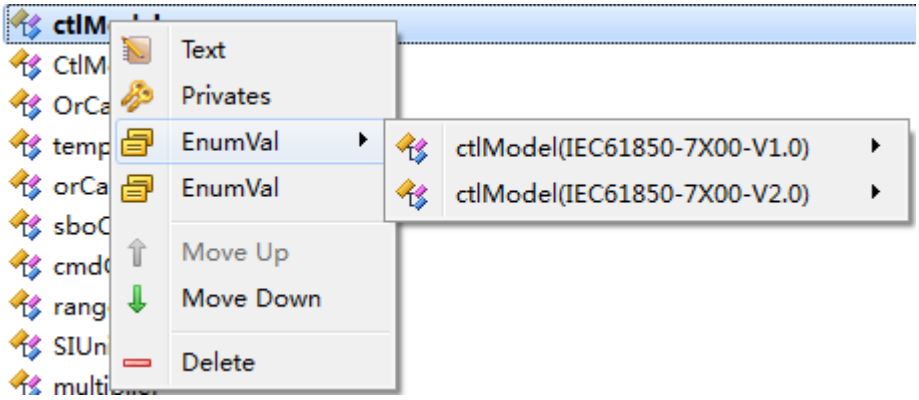


- Create customized **EnumTypes**

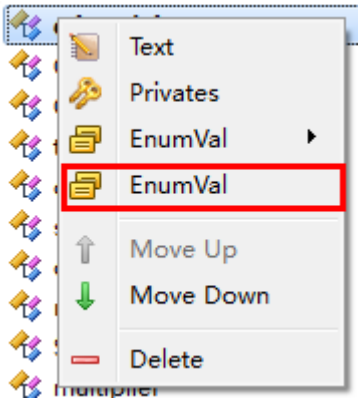


3.11.3.9. EnumVal Manipulation

- Create **EnumVals** by Inheritance



- Create customized **EnumVals**



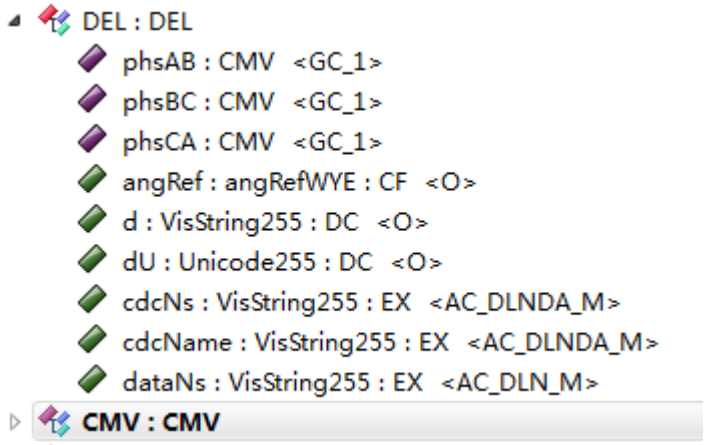
3.11.3.10. Auto Correction Model Integrity

Data Types defined within **DataTypeTemplates** are inter-referenced; any changes made to **LNodeType/DOType/DAType/EnumType** could affect the Model Integrity if users use Notepad/XML Browser or similar tools to edit SCL files; because those tools are only text-aware, not SCL language aware. A SCL language aware tool should be "intelligent" enough to propagate a chain of change events and execute a series of actions to protect the model from compromising integrity.

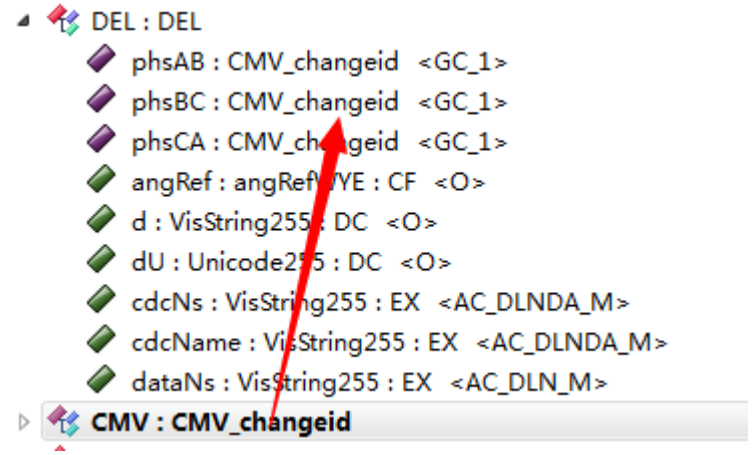
3.11.3.10.1. Change Event

- **Auto Correct Data Types Identifiers (scl:id)**

A value change of scl:id （**LNodeType/DOType/DAType/EnumType**）can propagate a chain of change events to the affected receivers, for example, **CMV** is referenced by three **SDOs**; before scl:id change, CMV looks like this：



After scl:id change, CMV looks like this (with auto correction)：



Users may not be aware of this auto corrections.

This propagation applied to the elements listed below:

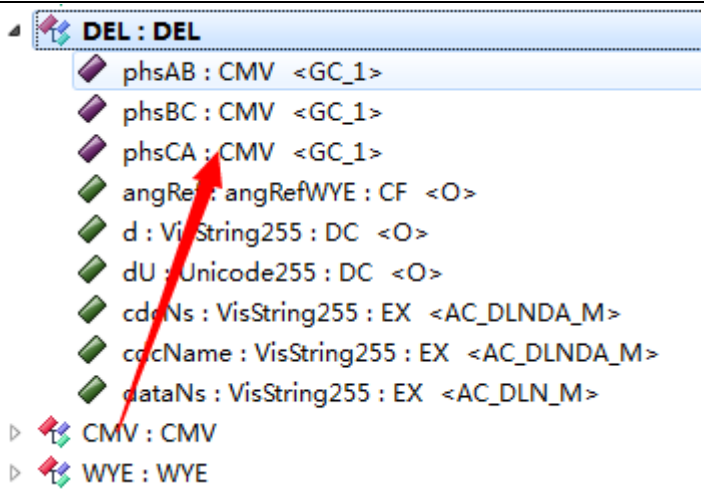
Element Name	Propagate Direction	Auto Corrected Elements
LNodeType	----------→	LN0 LN
DOType	----------→	DO SDO
DAType	----------→	DA BDA
EnumType	----------→	DA BDA

➢ Name Change Event (scl:name)

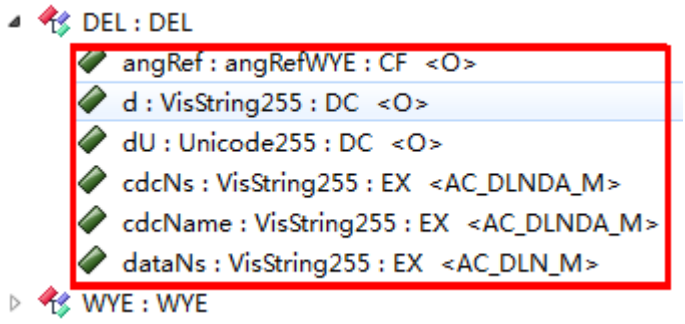
A value of scl:name（**DO/SDO/DA/BDA**） can be detected by the tool but no actions are taken right now, but tool provides **Model Integrity** check to help users pinpoint those errors.

3.11.3.10.2. Deletion Event

When any type of **LNodeType/DOType/DAType/EnumType** is deleted， all the related **LN/DO/DA/BDA** are no longer valid; the action taken is to delete them from model to protect model integrity. For example, before CMV deletion, it looks like this：



After CMV deletion, it looks like this：



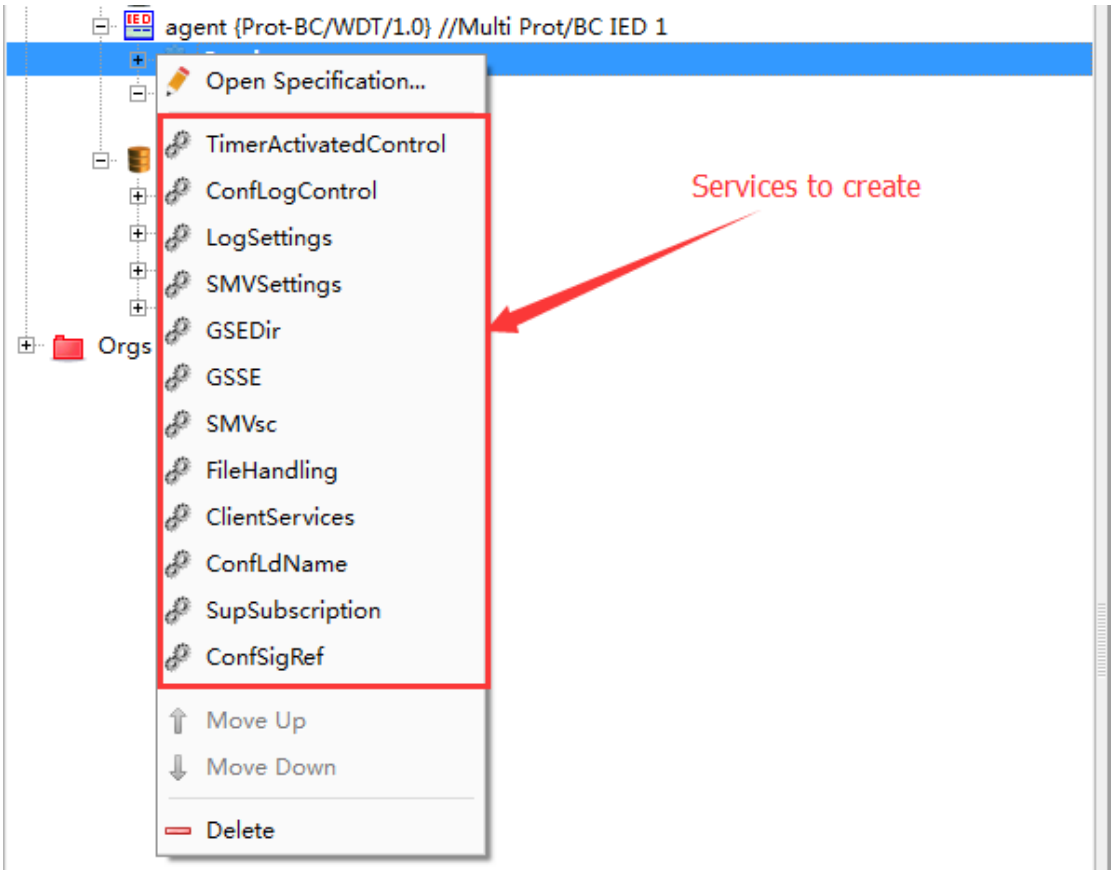
This propagation applied to the elements listed below:

Element Name	Propagate Direction	Elements to Delete
LNodeType	----------→	LN0 LN
DOType	----------→	DO SDO
DAType	----------→	DA BDA
EnumType	----------→	DA BDA

3.11.4. IED Manipulation

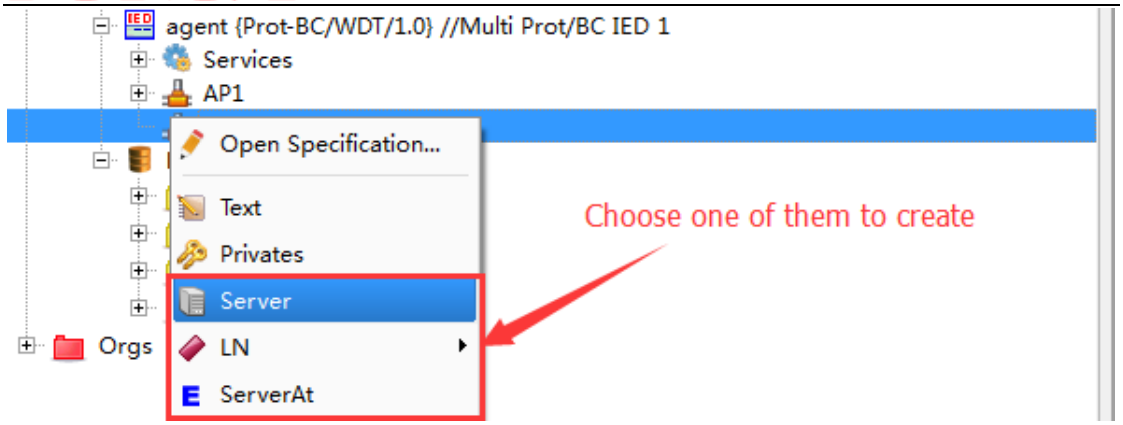
3.11.4.1. Services

Choose the required services from **dropbox**:



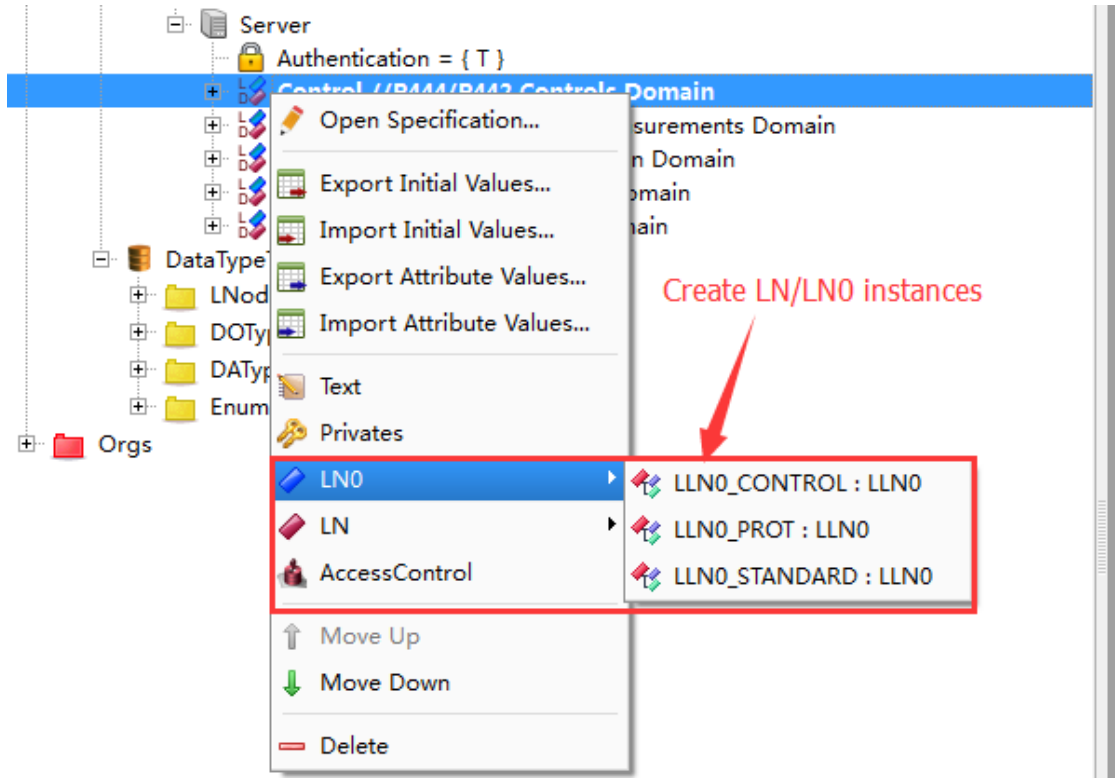
3.11.4.2. AccessPoint

Choose **Server**/**LN**/**ServerAt** from the **dropbox**:

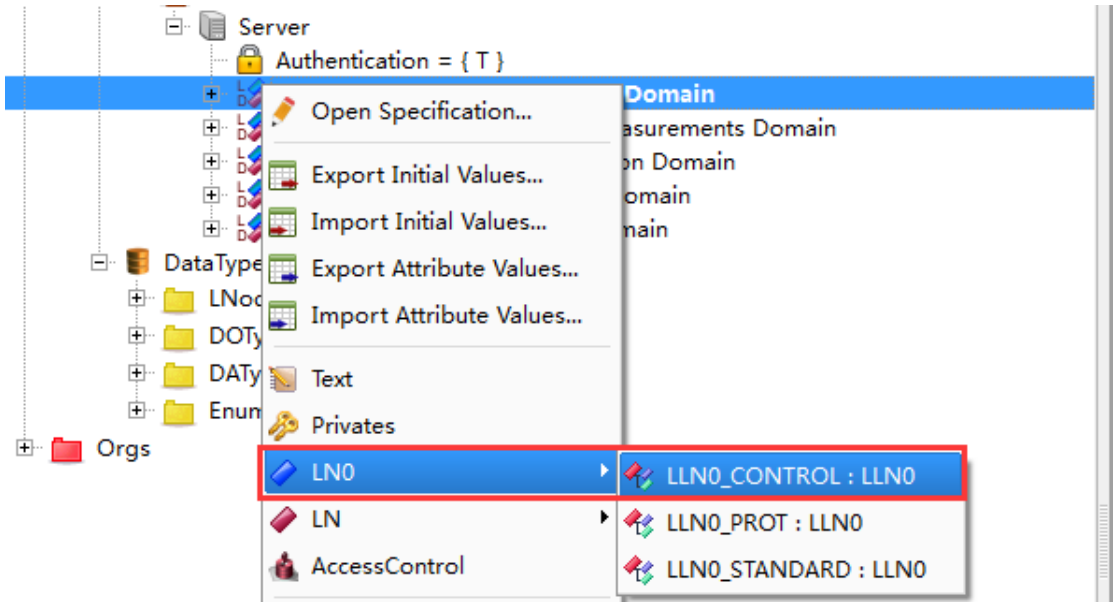


3.11.4.3. LDevice

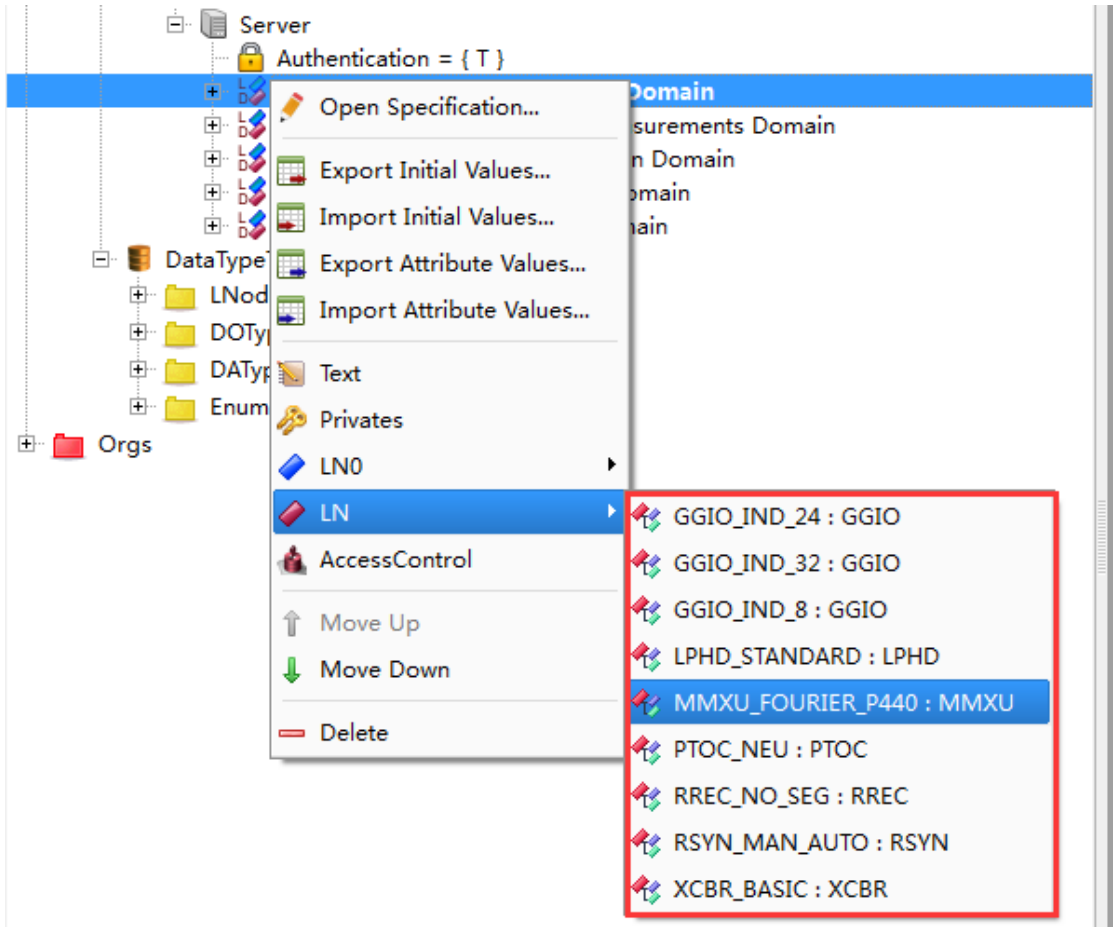
Choose LNodeType from **dropbox** to create **LN0/LN**



Create LN0 instance:



Create LN instances:

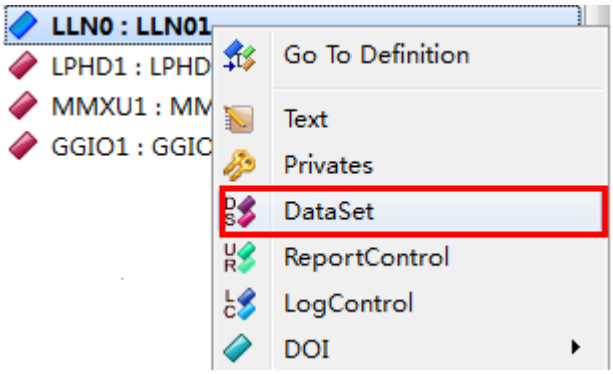


LN creation is as simple as choosing **LNodeType** from a prompted **dropbox**, if you create more than one **LNs** of the same **LNodeType**, the tool will automatically increase the **Suffix**. Users can also clone an existing **LN** by clicking toolbar button .

3.11.4.3.1. LN0/LN

3.11.4.3.1.1. DataSet

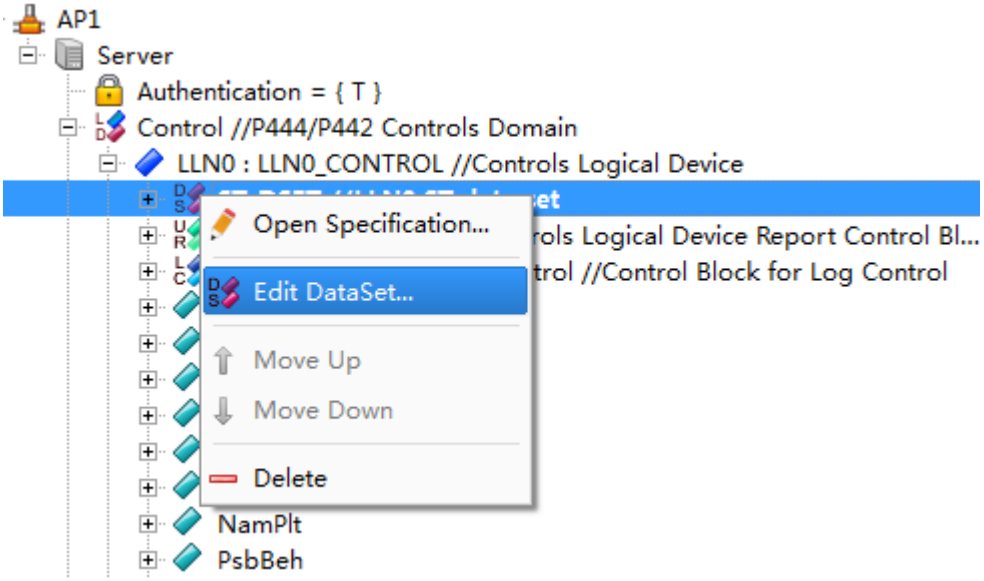
3.11.4.3.1.1.1. Create DataSet



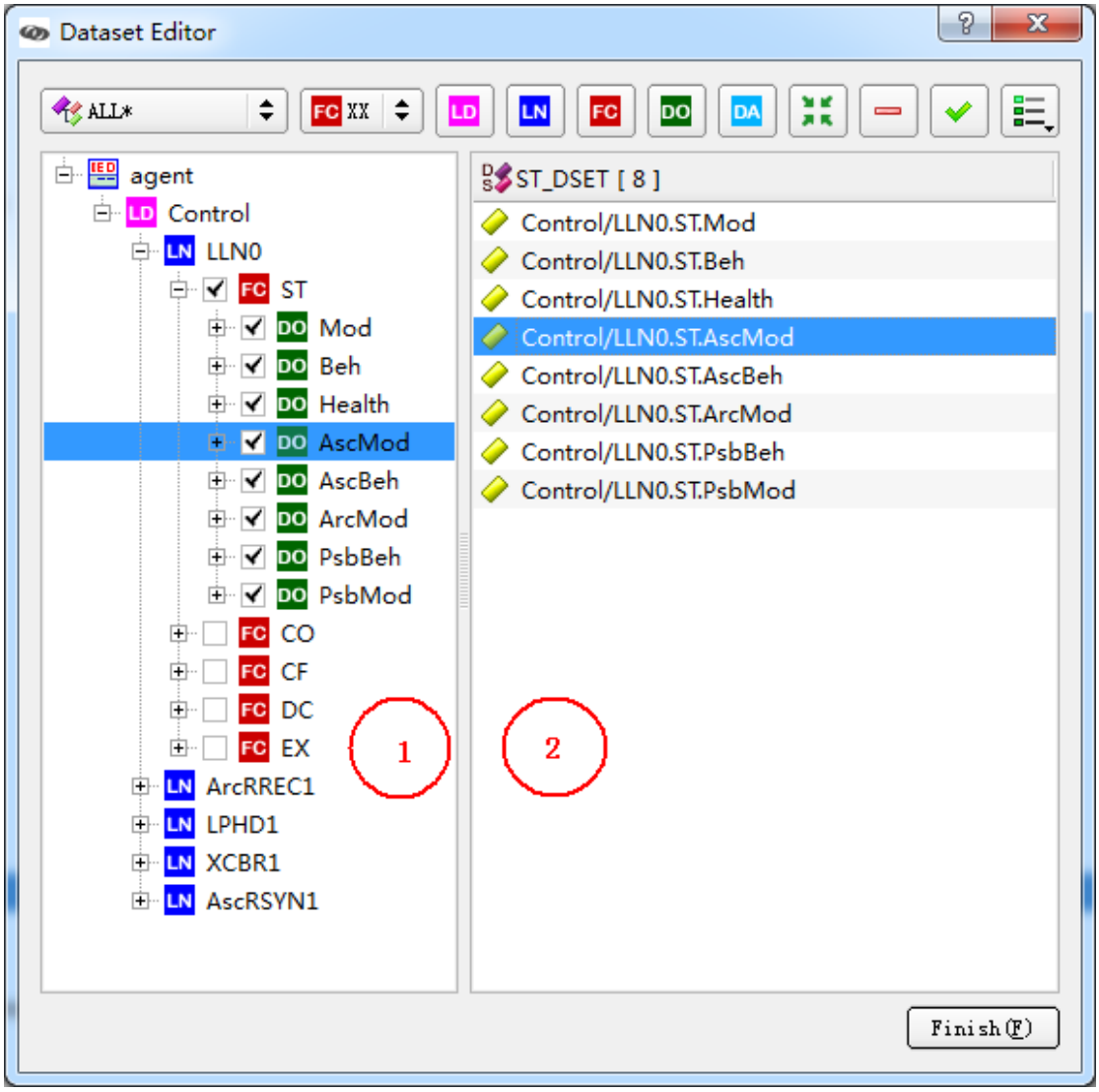
Choose **DataSet** from **dropbox**.

3.11.4.3.1.1.2. Edit DataSet

- **Introduction to DataSet Editor**

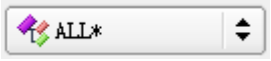


Choose **Edit DataSet…**:



The **DataSet Editor** is composed of two parts marked as ① and ② respectively:

The left window marked ① is the model instance tree; here the user can browse and navigate to any data entries **FCDA**. The window on the right marked ② is **DataSet** entries window. At the top of the window, there are a couple of dropboxes, and several tool buttons.



: Filter model instances by **LNodeType**

: Filter model instances by **Functional Constraint**

: Expand/collapse model instance tree down to the levels of LD, LN, FC, DO or DA

: Collapse all model instances

: Delete the selected entries from the DataSet

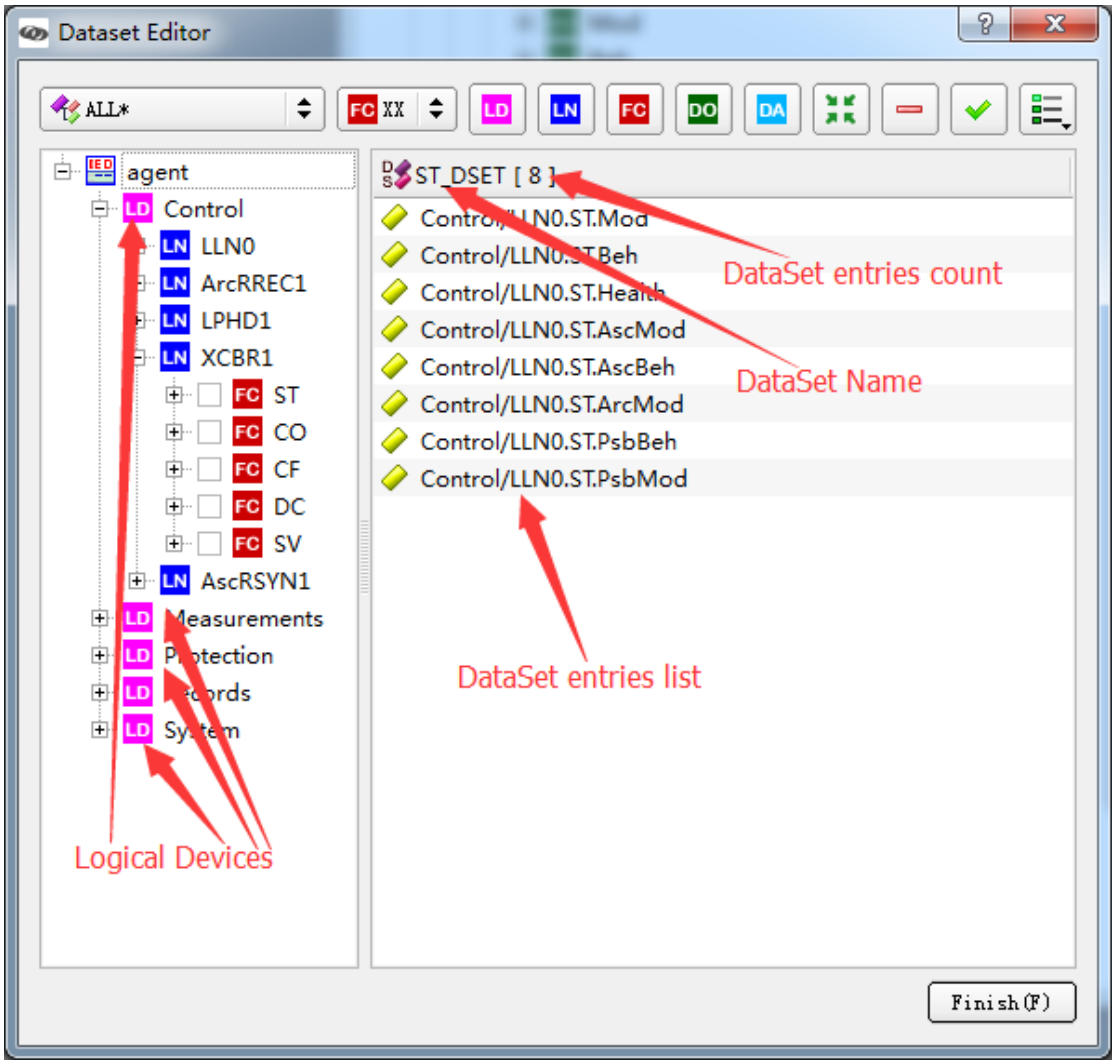
: Validate the added DataSet entries

: Show/hide any other columns information

Note: If you intend to add dataset entries from any other Logical Devices of the same IED, please go to **System Settings** section for more details.

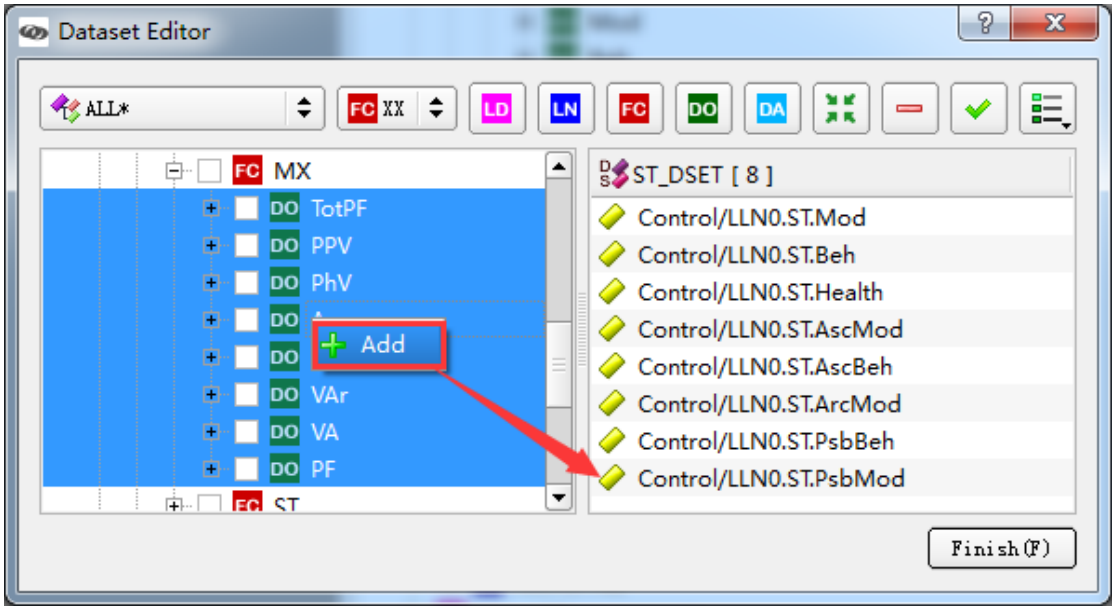
➢ Add DataSet Entries

DataSet Editor is a comprehensive wizard:

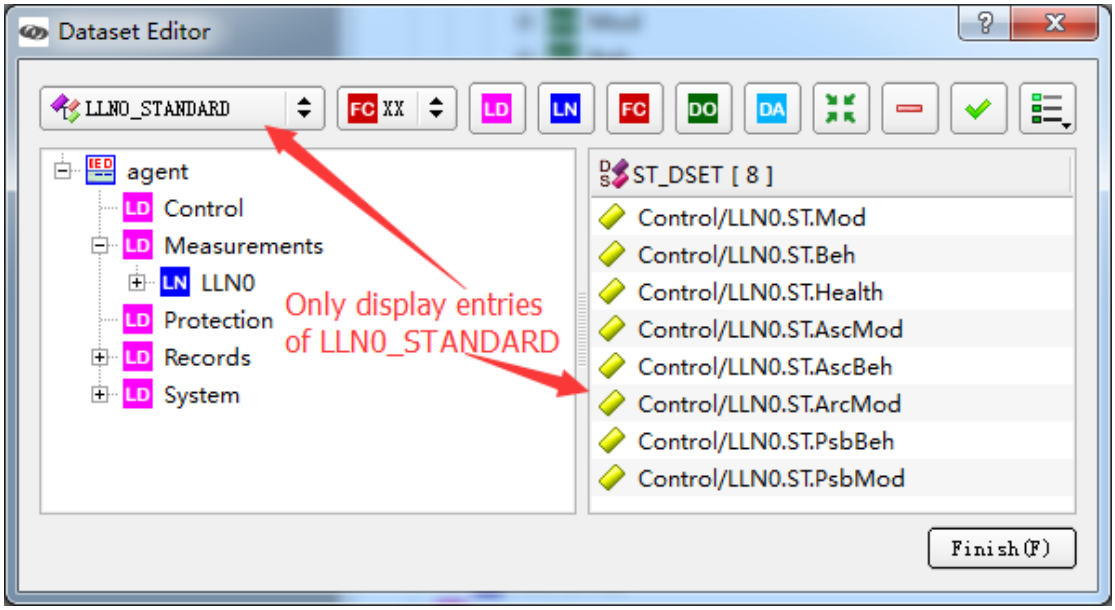


IED Model Design

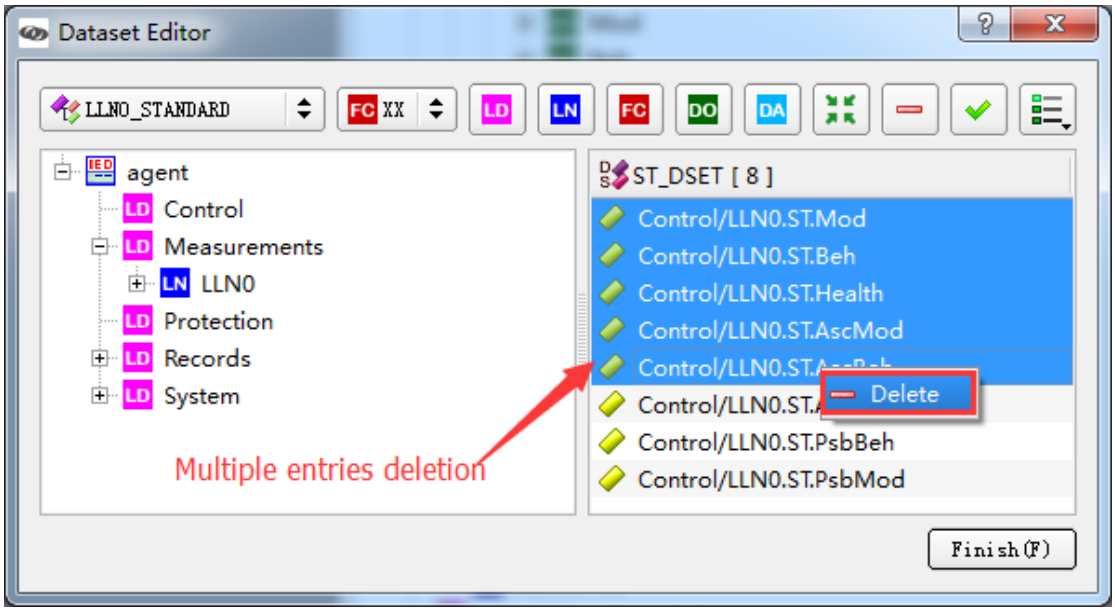
Multiple entries selection:



DataSet entries filter:

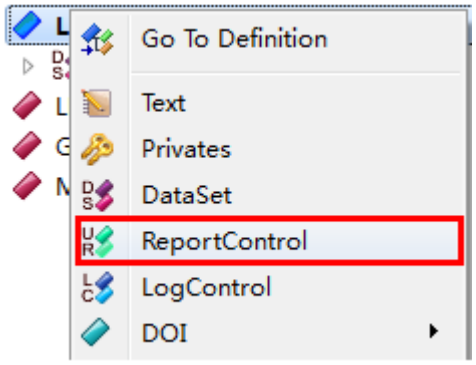


➢ **Delete DataSet Entries**

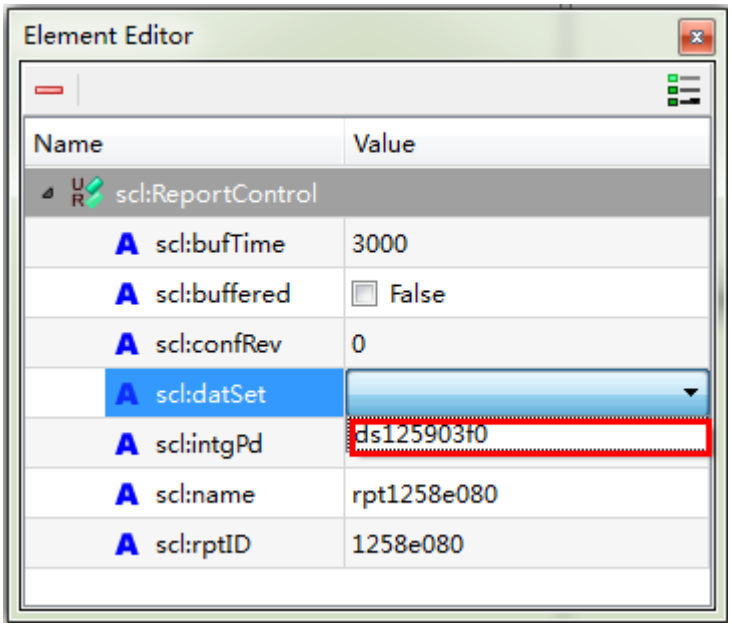


3.11.4.3.1.2. ReportControl

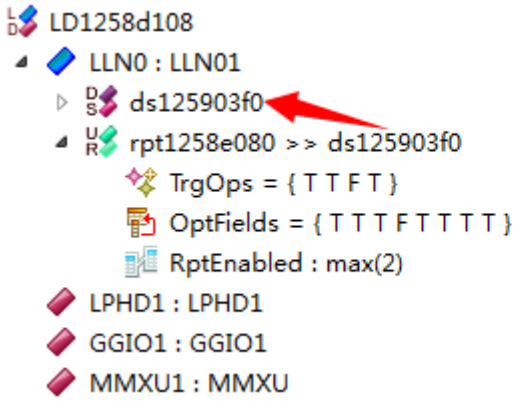
➢ **Add ReportControl Block**



➢ **Change Attribute's Values**



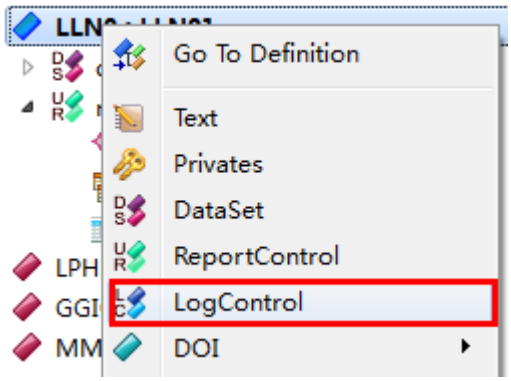
➢ **Presenation**


LD1258d108
LLN0 : LLN01
ds125903f0
rpt1258e080 >> ds125903f0
TrgOps = { T T F T }
OptFields = { T T T F T T T T }
RptEnabled : max(2)
LPHD1 : LPHD1
GGIO1 : GGIO1
MMXU1 : MMXU

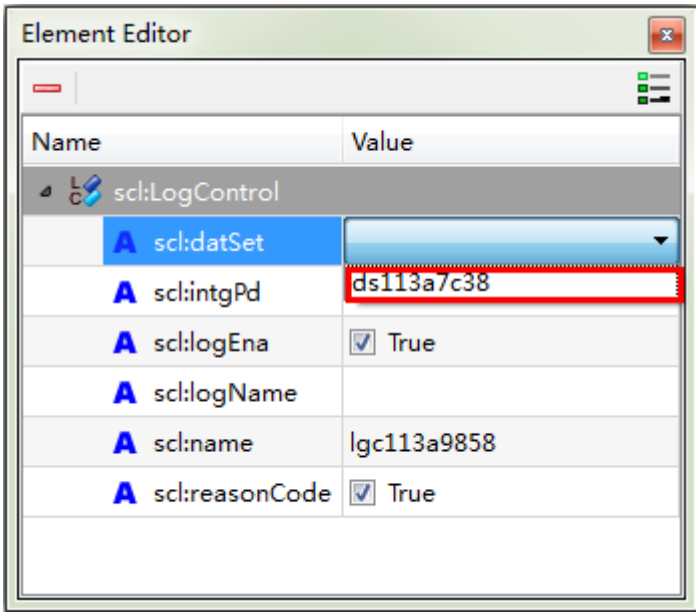
Format：Control Block Name >> DataSet Name

3.11.4.3.1.3. LogControl

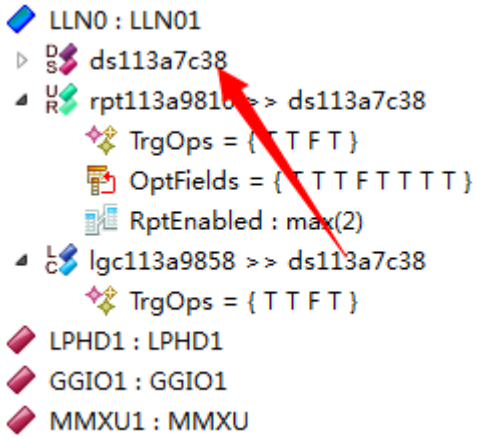
➢ **Add LogControl Block**



➢ Change Attribute's Values



➢ Presentation


LLN0 : LLN01
ds113a7c38
rpt113a9810 >> ds113a7c38
TrgOps = { T T F T }
OptFields = { T T T F T T T T }
RptEnabled : max(2)
lgc113a9858 >> ds113a7c38
TrgOps = { T T F T }
LPHD1 : LPHD1
GGIO1 : GGIO1
MMXU1 : MMXU

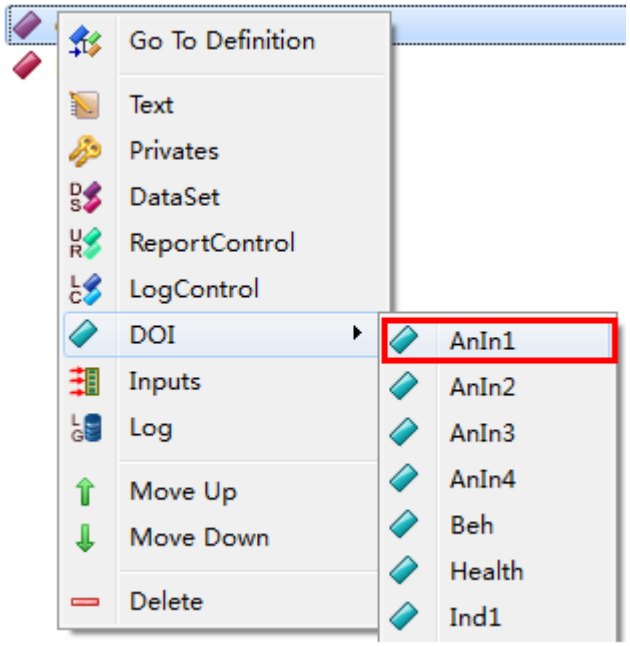
Format: Control Block Name >> DataSet Name

3.11.4.3.1.4. DOI

➢ Add DOI

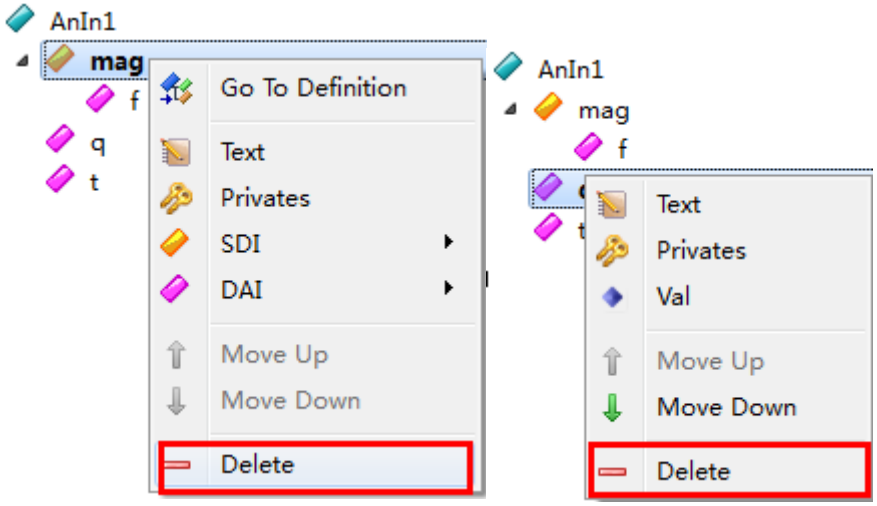
To add **DOI** select the **DOI** required from dropbox. The tool will automate the full creation of **DOI**. The full creation covers all levels of **SDI/DAI** and **Val** default value assignment if available from **DBA/DA**. This type of **Intelligent Creation** saves time and avoids errors

1. Select the **DOI** to create

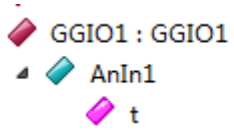


2. Intelligent creation of **DOI**

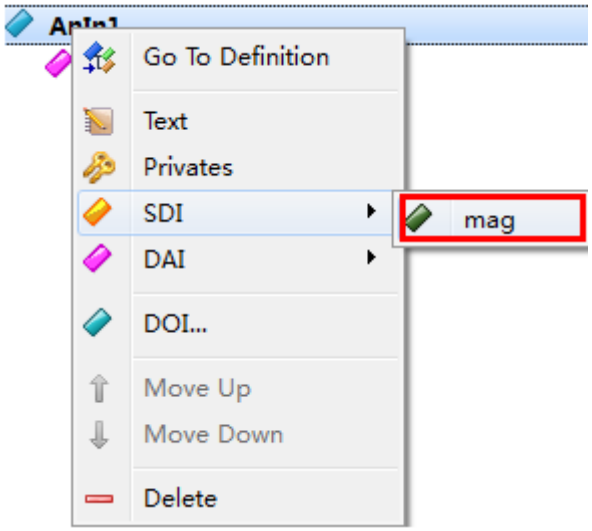
3. Selective deletion of **SDI/DAI** (mag , q)

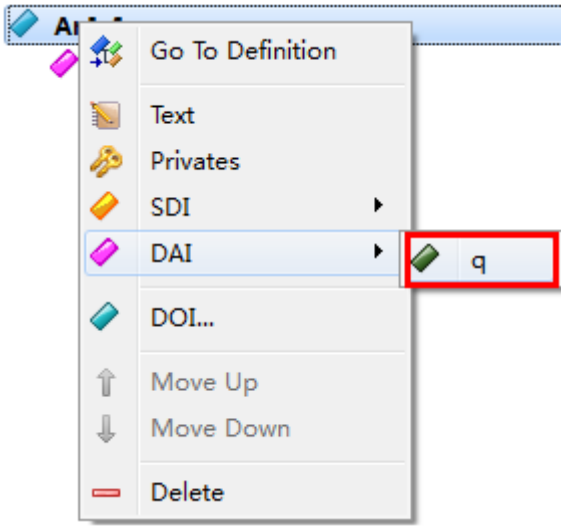


4. After selective deletion of **SDI/DAI** (mag , q)



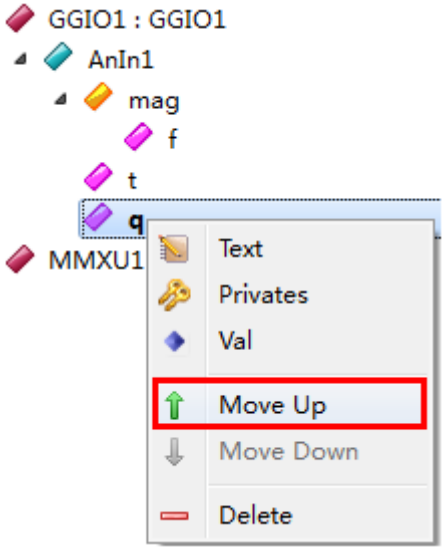
5. Selective addition of **SDI/DAI** (mag , q)





6. After selective addition of **SDI/DAI** (mag , q)

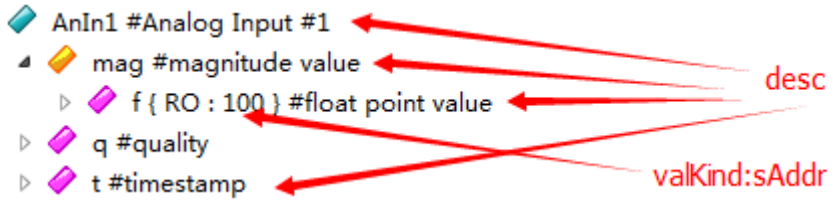
7. Reposition of **SDI/DAI** (q)



Note: Repositioning Element is enabled by Drag & Drop operation too.

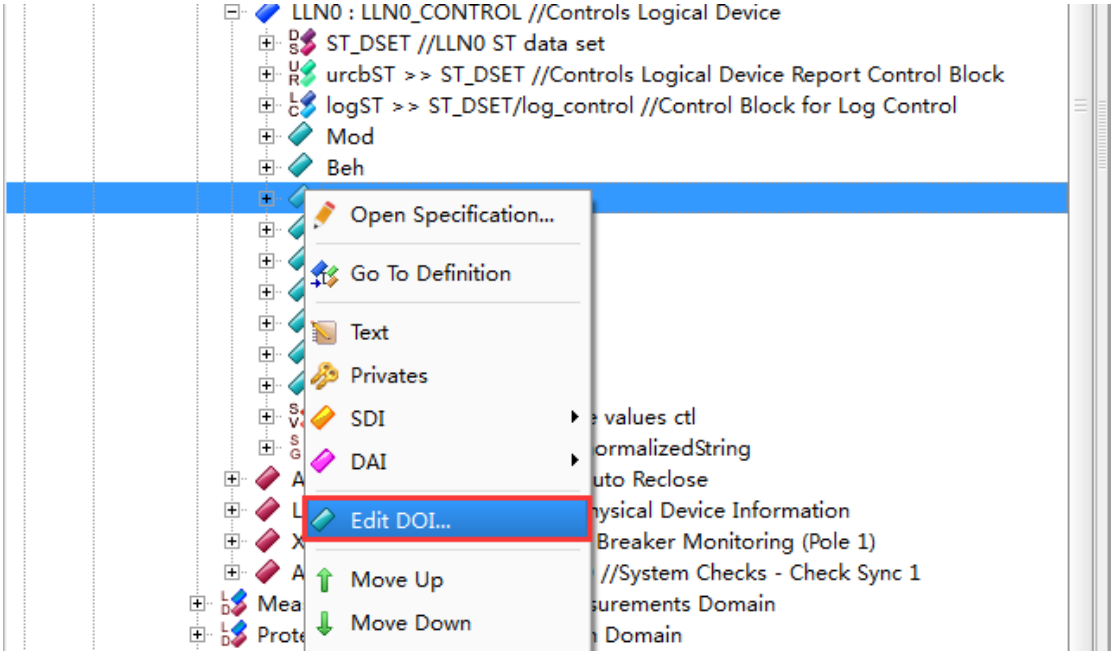
➢ Edit DOI

DOI is composed of set of **Data Attributes** organized in hierarchical structure. In practice it is necessary to configure initial values of **Val** and some important attributes, such as **sAddr**, **valKind**, **desc** etc.

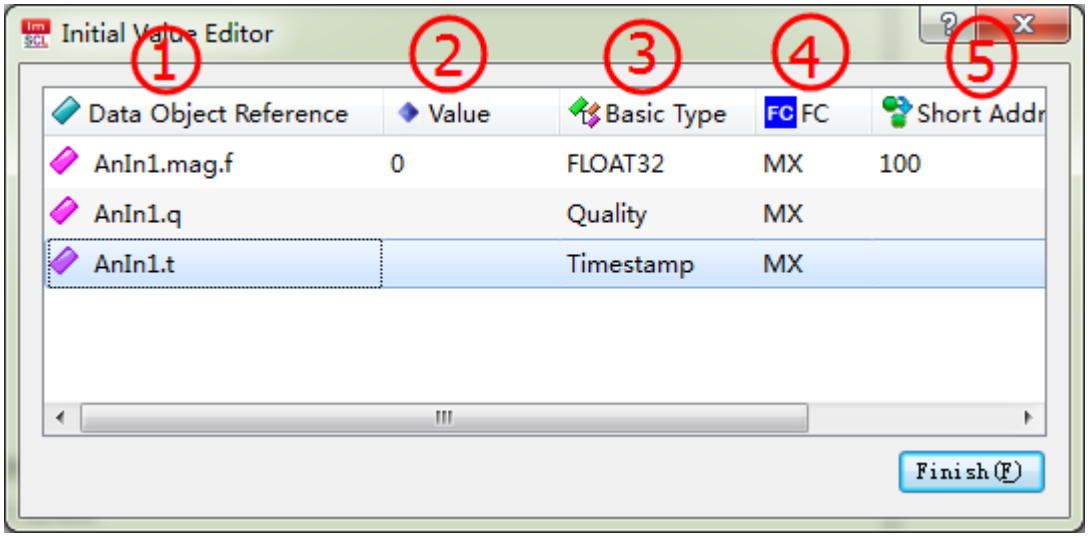


1. Introduction to **Initial Value Editor**

Choose **Edit DOI…** from context menu.



Overview of **Initial Value Editor**:



There are five columns in the Data Attributes entries list, marked as ①、②、③、④、⑤ respectively.

① : Data Attributes flattened name (Data Object Reference)

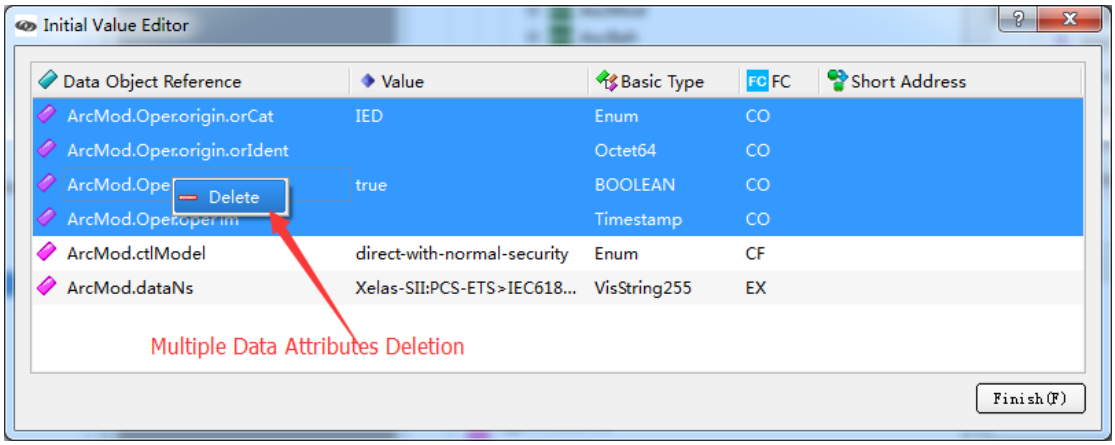
② : Data Attributes Value

③ : Data Attributes Basic Type

④ : Functional Constraint (FC)

⑤ : Short address (sAddr)

2. Delete **Data Attributes** entries

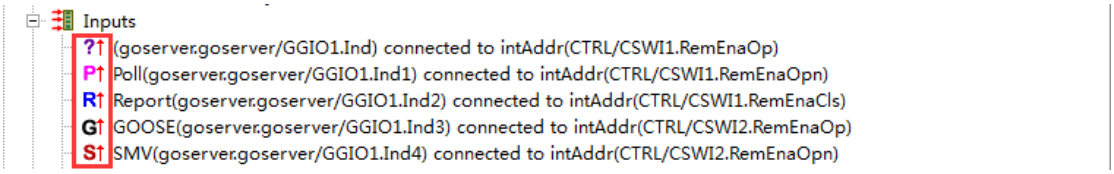


By default, **DOI** creation will create all Data Attributes entries, but in practice only some of them are configured e.g. those with Functional Constraint **CF**, **EX**, **DC** etc. Users should delete those entries that are unnecessary from **DOI** to avoid making the SCL model much bigger in size. This is

especially the case for resource constrained devices (IEDs).

3.11.4.3.1.5. Inputs

This version of the tool does not have a feature to facilitate the creation of **scl:ExtRef;**, users must create these manually and be responsible for their correctness.


Inputs
?↑ (goserver.goserver/GGIO1.Ind) connected to intAddr(CTRL/CSWI1.RemEnaOp)
P↑ Poll(goserver.goserver/GGIO1.Ind1) connected to intAddr(CTRL/CSWI1.RemEnaOpn)
R↑ Report(goserver.goserver/GGIO1.Ind2) connected to intAddr(CTRL/CSWI1.RemEnaCls)
G↑ GOOSE(goserver.goserver/GGIO1.Ind3) connected to intAddr(CTRL/CSWI2.RemEnaOp)
S↑ SMV(goserver.goserver/GGIO1.Ind4) connected to intAddr(CTRL/CSWI2.RemEnaOpn)

The picture above defines five External References:

?↑: Doesn't specify what type of service (scl:serviceType)

P↑: Service type of **Poll**

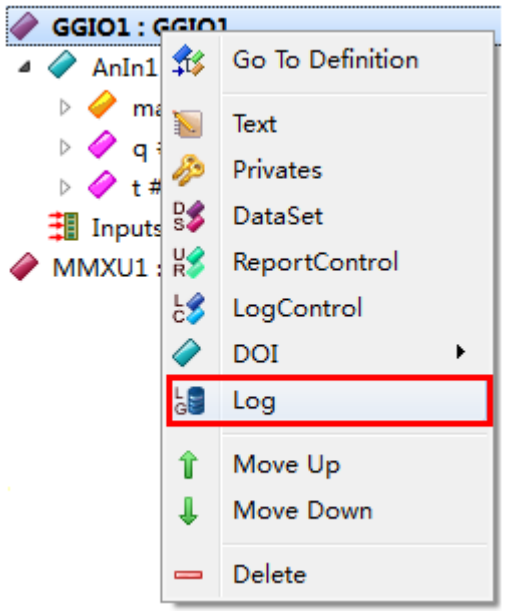
R↑: Service type of **Report**

G↑: Service type of **GOOSE**

S↑: Service type of **SMV**

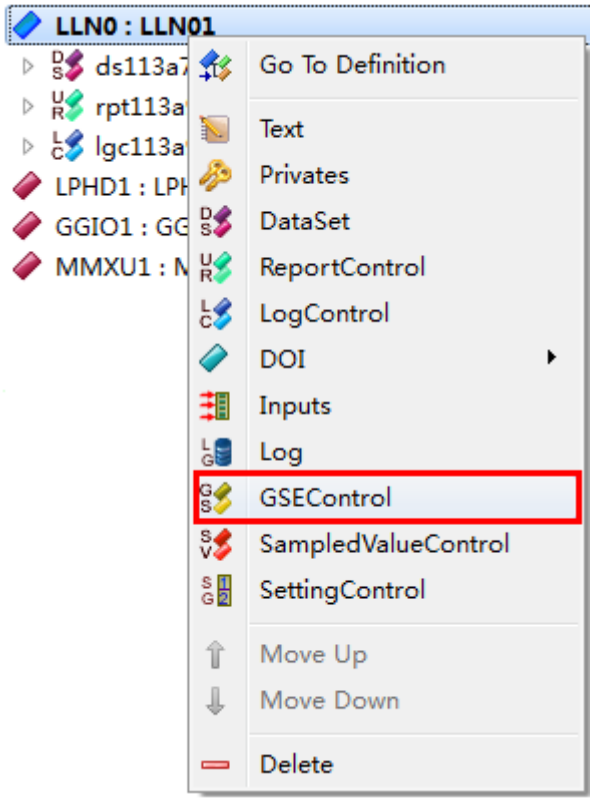
3.11.4.3.1.6. Log

To create a **Log** is very simple.

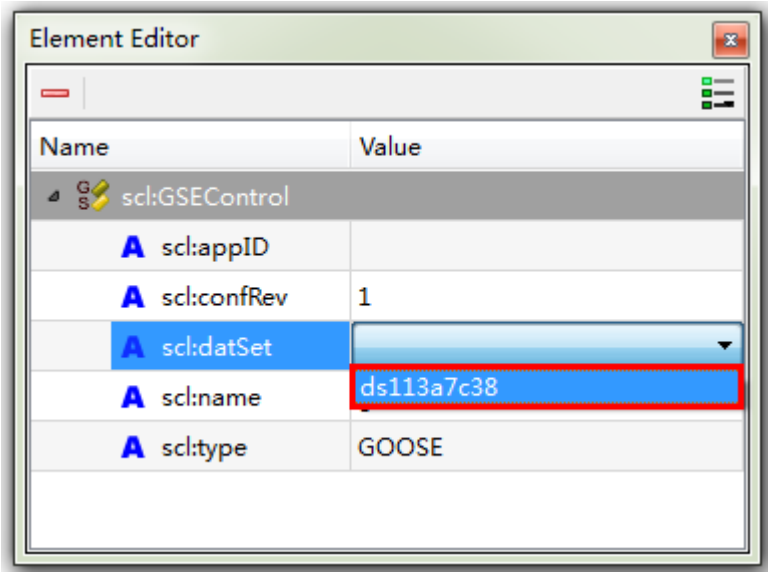


3.11.4.3.1.7. GSEControl

- **Create GSEControl Block**



- **Change Attributes Values**

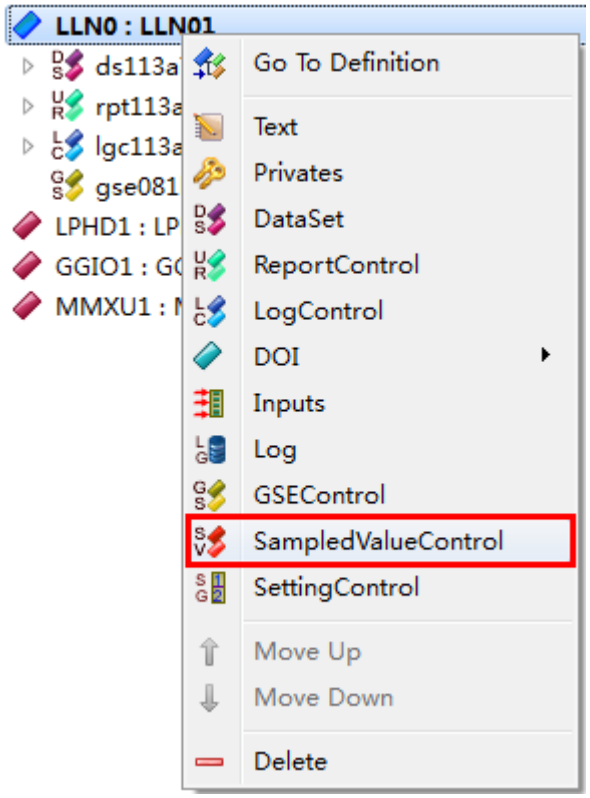


- **Presentation**

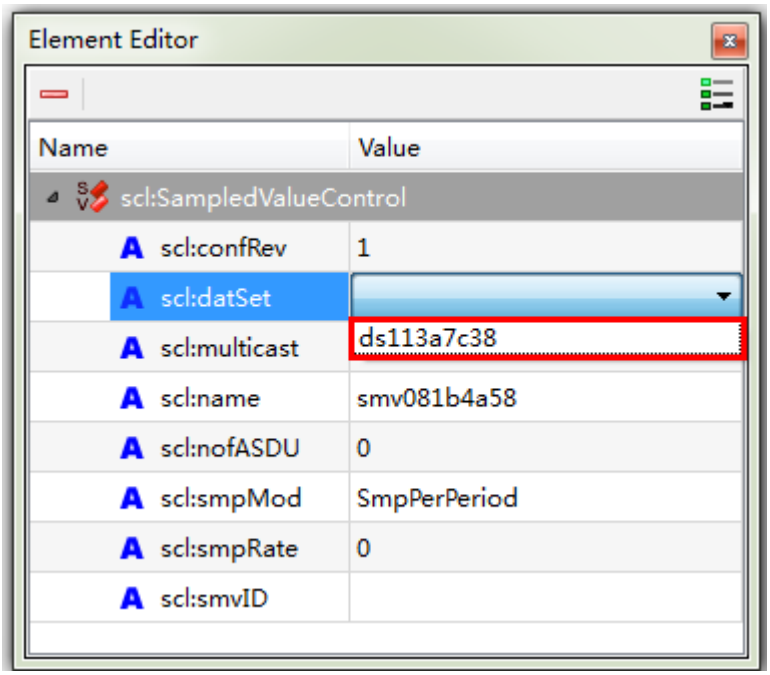
Format: GSEControl Block name >> DataSet Name

3.11.4.3.1.8. SampledValueControl

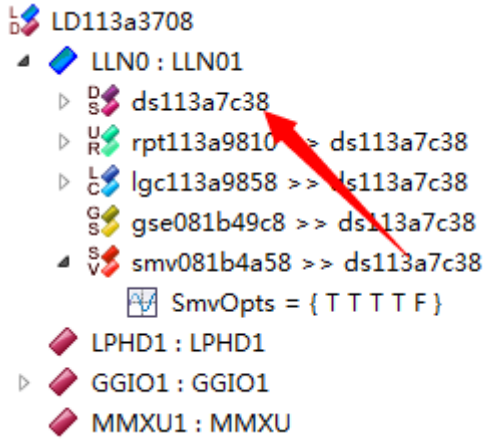
➢ Create SampledValueControl Block



➢ Change Attributes Values

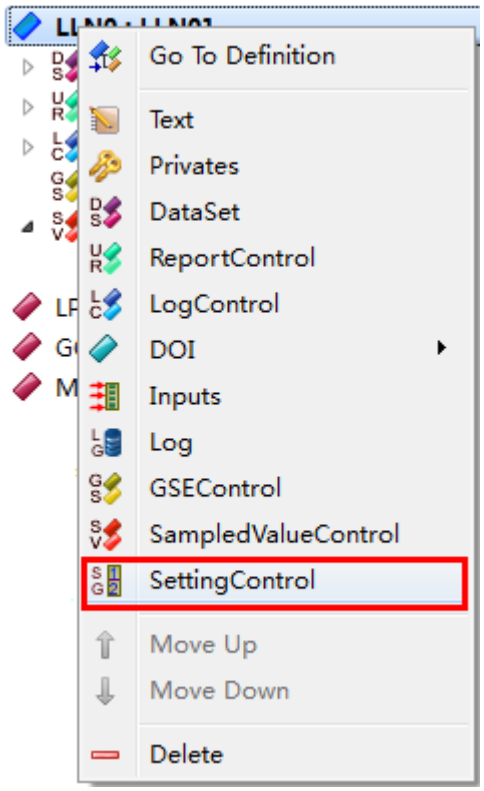


➢ Presantation



Format：SampledValueControl Block name >> DataSet Name

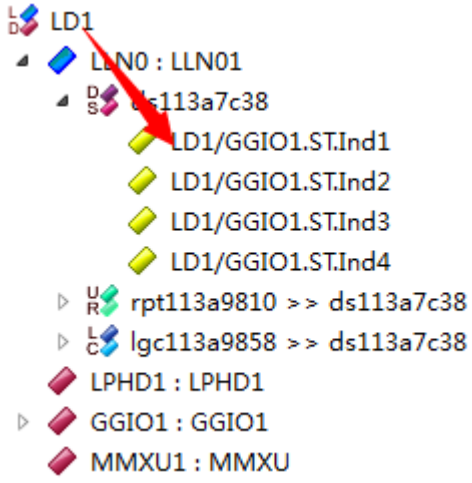
3.11.4.3.1.9. SetttingControl



3.11.4.3.1.10. Auto Correction Model Integrity

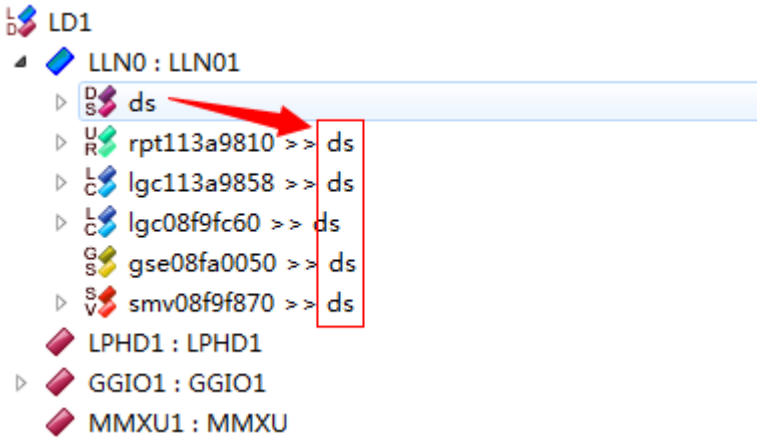
3.11.4.3.1.10.1. FCDA Auto Correction

Element Name	Propagate Direction	Auto Corrected Elements
LD：inst	----------→	FCDA：ldInst
LN：prefix/lnClass/inst	----------→	FCDA：prefix/lnClass/lnInst



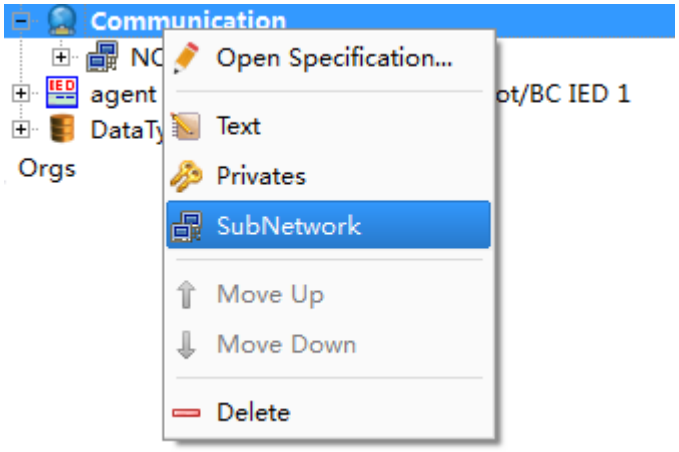
3.11.4.3.1.10.2. Control Blocks Auto Correction

Element Name	Propagate Direction	Auto Corrected Elements
DataSet：name	----------→	ReportControl：datSet
	----------→	LogControl：datSet
	----------→	GSEControl：datSet
	----------→	SampledValueControl：datSet



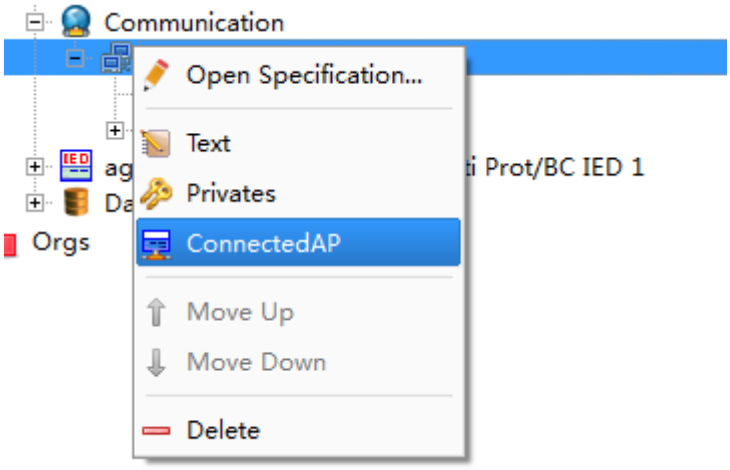
3.11.5. Communication Manipulation

3.11.5.1. SubNetwork



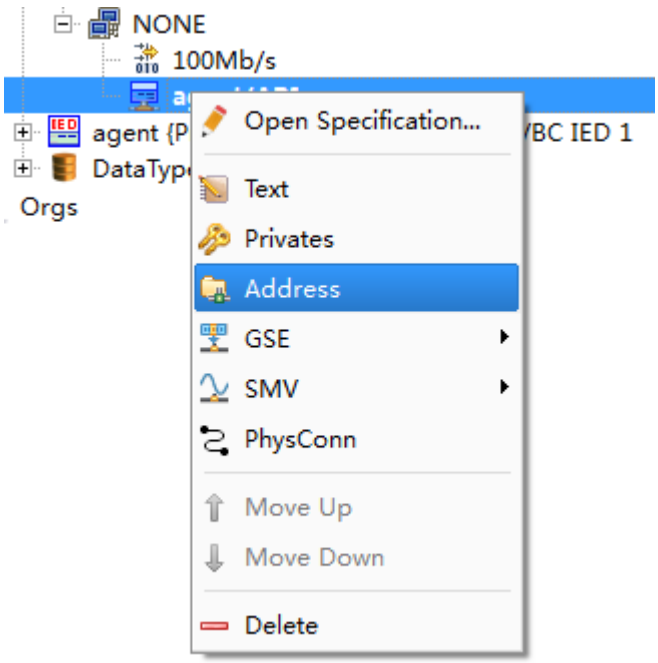
Choose **SubNetwork** to create **SubNetwork** elements.

3.11.5.2. ConnectedAP

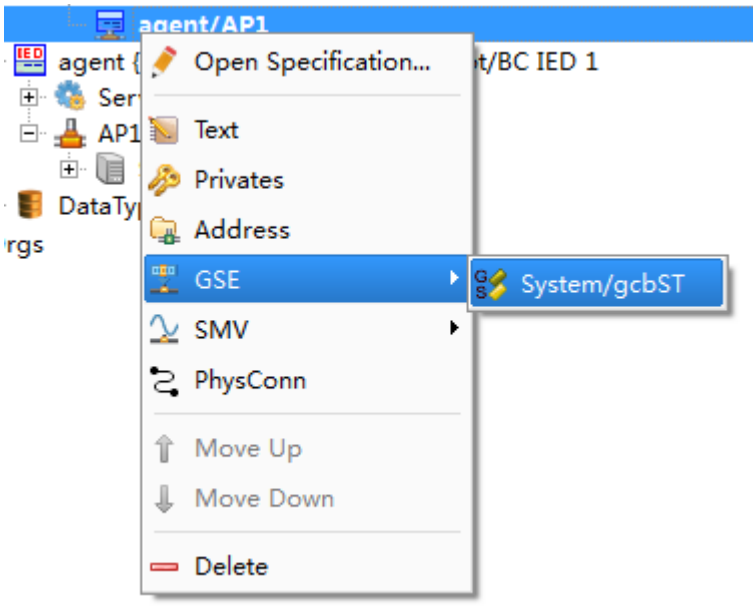


Choose **ConnectedAP** to create **ConnectedAP** elements.

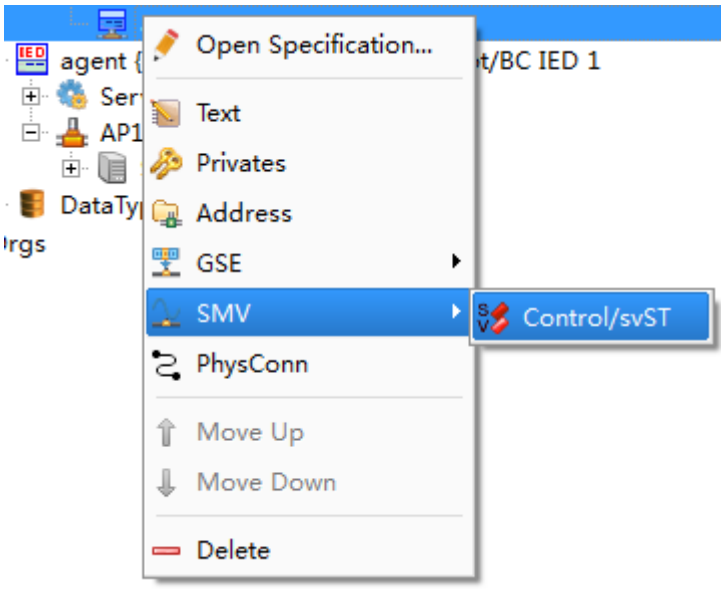
3.11.5.2.1. Address



3.11.5.2.2. GSE



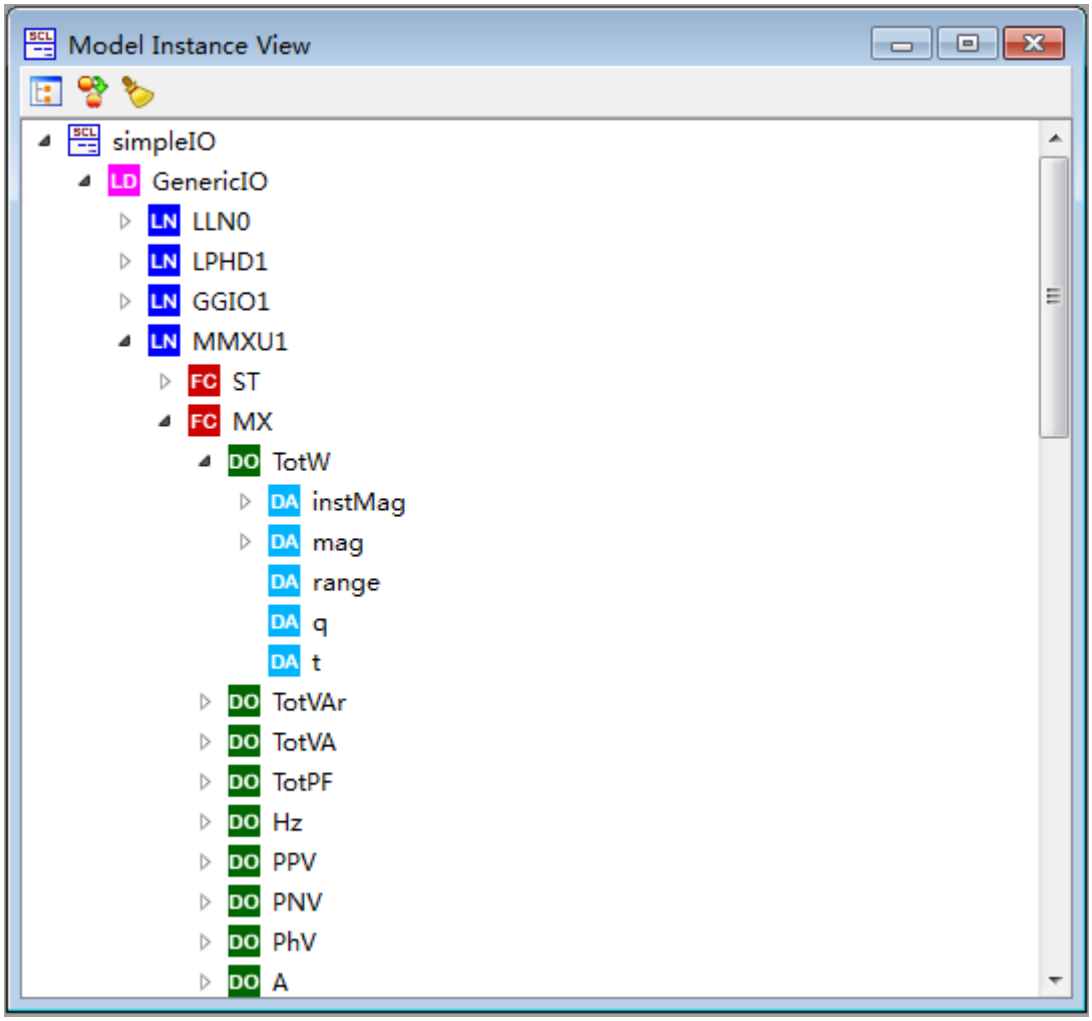
3.11.5.2.3. SMV



3.12 Model Instantiations

There are two types of Model Instantiations supported: MMS Mapping Model, ACSI General Model.

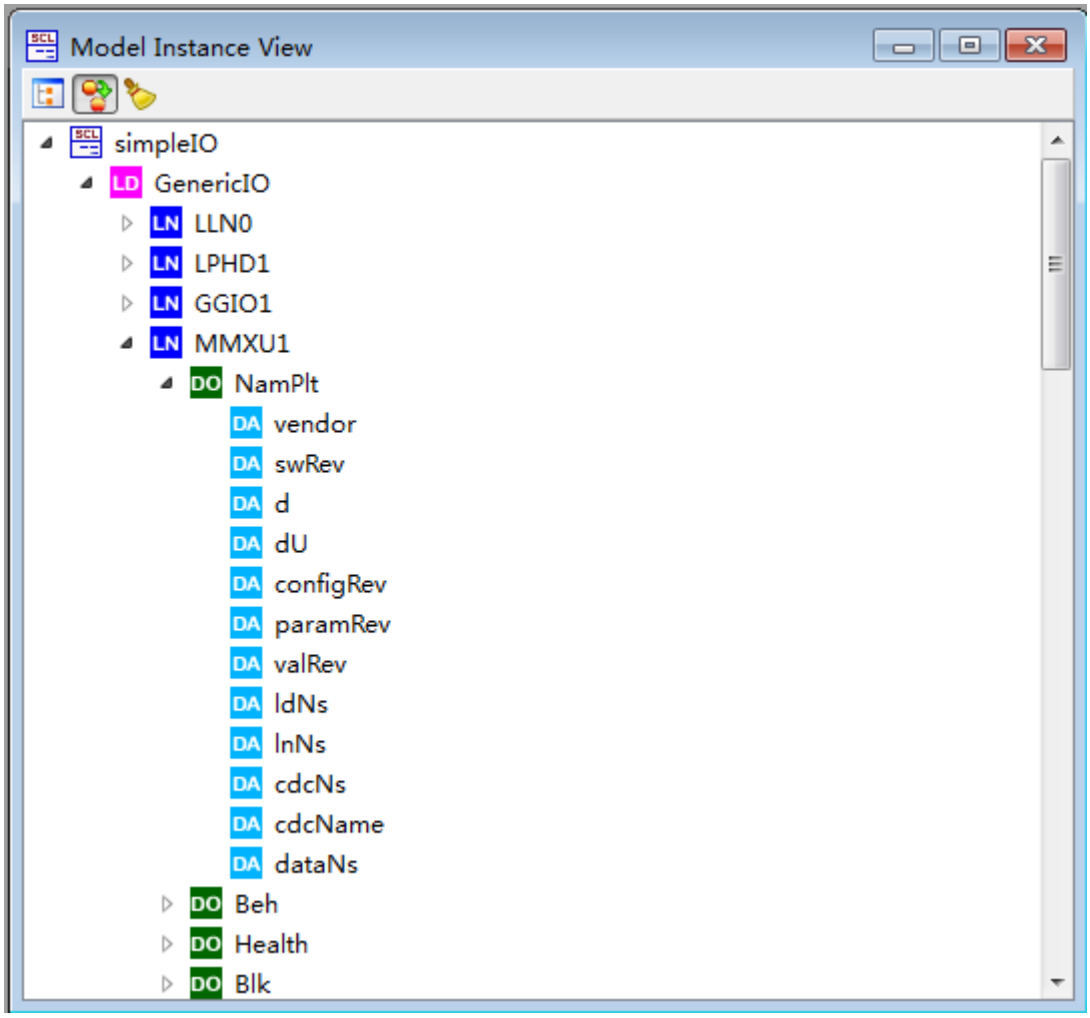
3.15.1. MMS Mapping Model



: To create instantiated model

: Switch between MMS Mapping and ACSI General

3.15.2. ACSI General Model

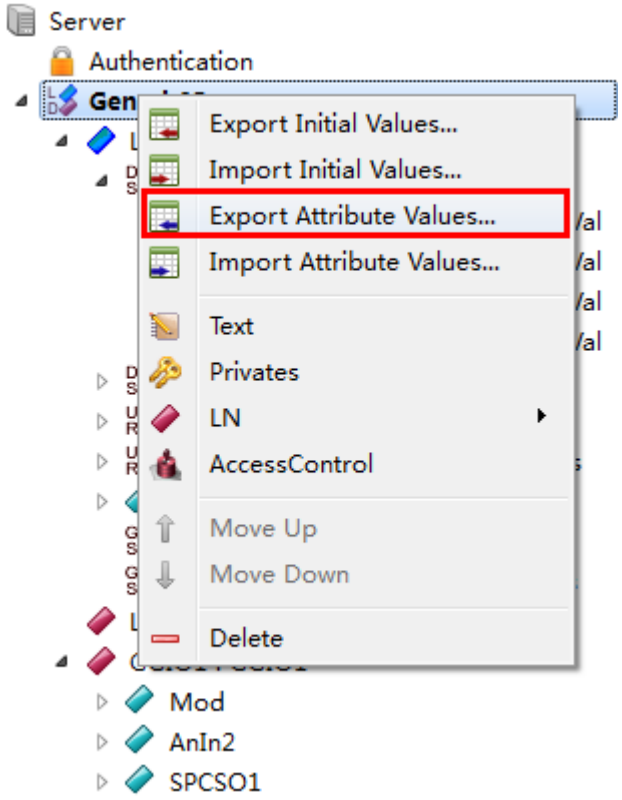


3.13 Batch Edit Attribute Values

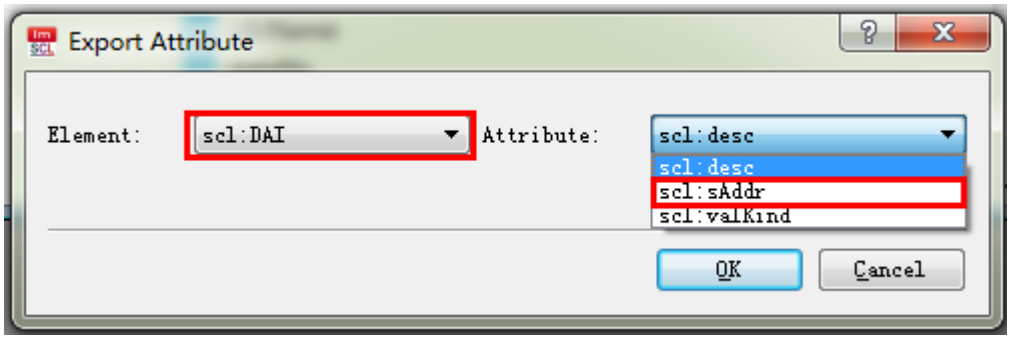
SCL is organized in hierarchical structure. To batch edit Attribute Values, we need to flatten those names into a table and export it to edit by external tools like **Excel**.

3.16.1. Export LN/DOI/DAI Attributes

- Export CVS Data Format



- Select Element and its Attribute to export



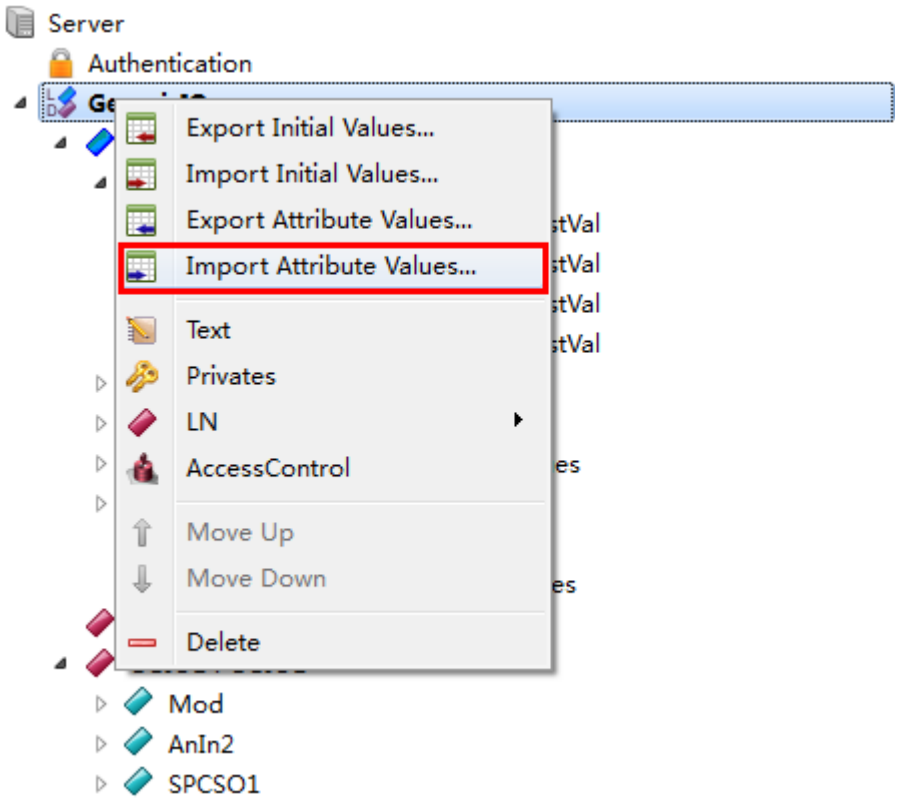
3.16.2. Edit LN/DOI/DAI Attributes with external tool

Edit it with **Excel**:

Object Reference Type	Attribute Name	Attribute	FC
Struct|AnalogueValue_1	scl:sAddr	101	MX
Timestamp	scl:sAddr	102	MX
Enum|CtlModels	scl:sAddr		CF
	scl:sAddr		
Enum|CtlModels	scl:sAddr		CF
	scl:sAddr		
Enum|CtlModels	scl:sAddr		CF
Enum|CtlModels	scl:sAddr		CF

3.16.3. Import LN/DOI/DAI Attributes

CVS Format File:



3.14 Batch Edit Val

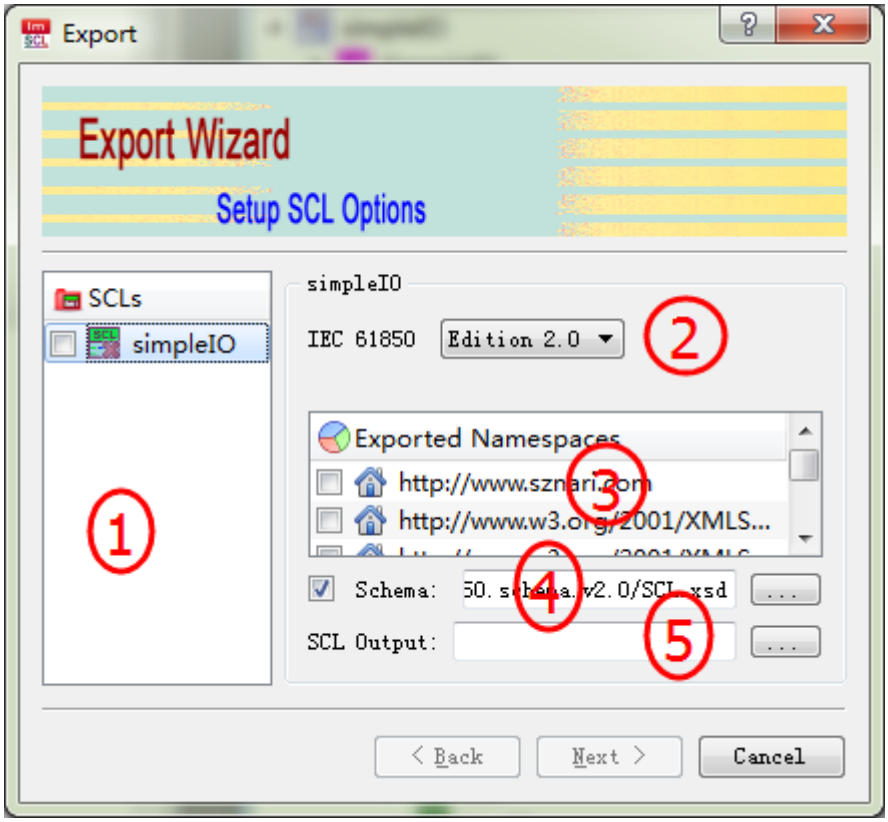
The same as batch edit Attribute Values.

3.15 Export SCL

3.18.1. Export Wizard

- Trigger Export

- Basic Settings



① Select which SCL(s) to export

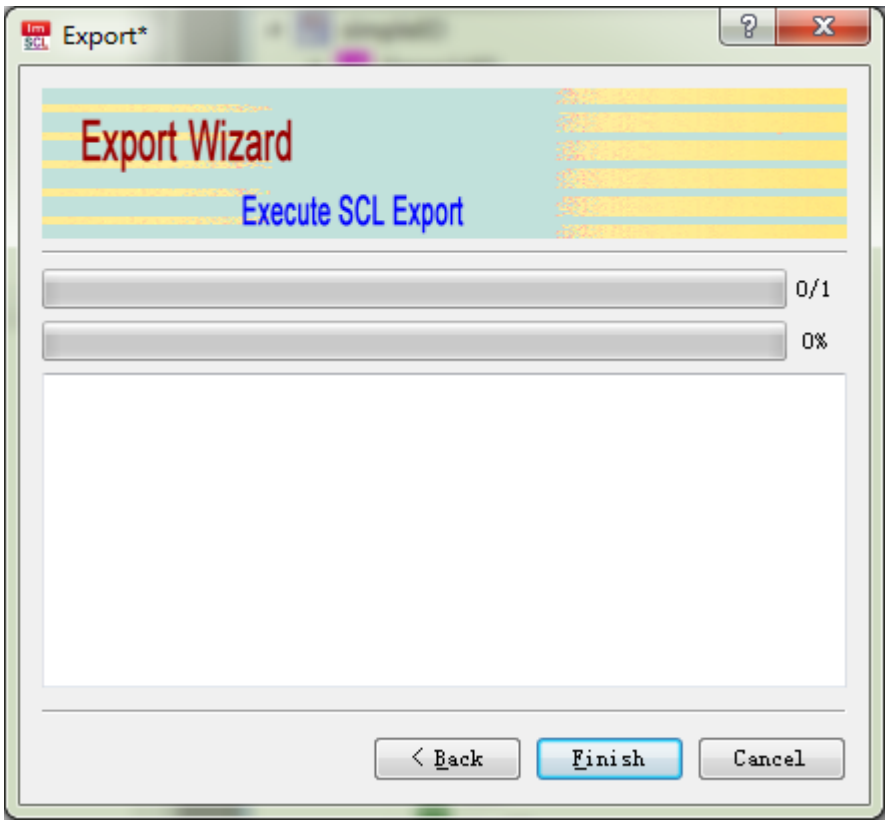
② Specify IEC 61850 edition (1.0/2.0)

③ Specify Private Namespaces to export

④ Specify SCL Schema if any

⑤ Specify the output SCL file name

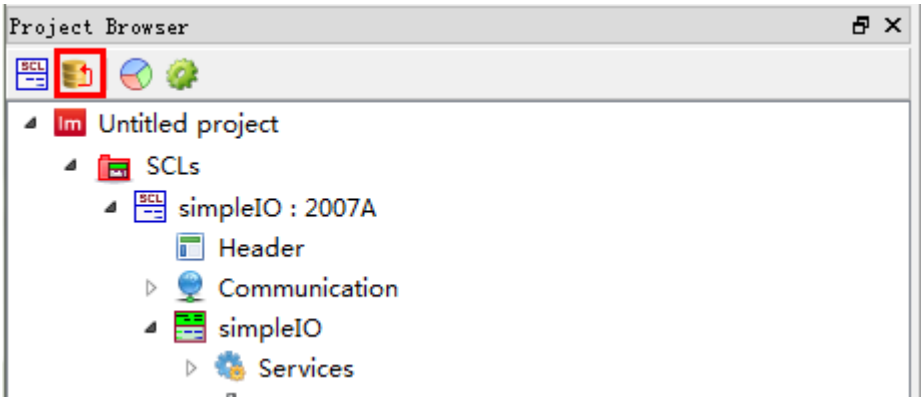
- Execution



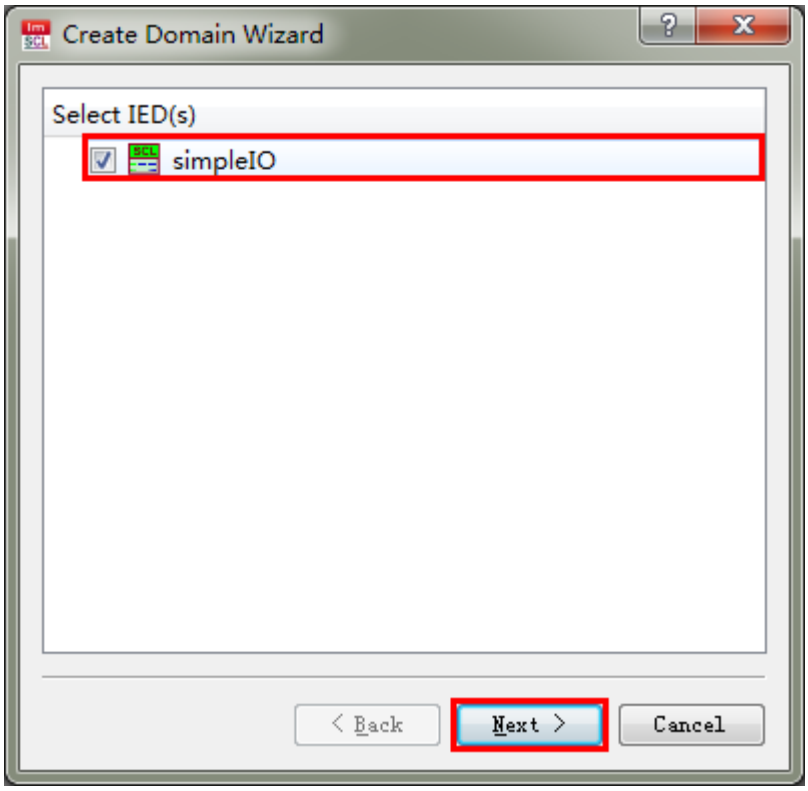
3.16 Domain Creation

Users can create compatible **Domains** of their own.

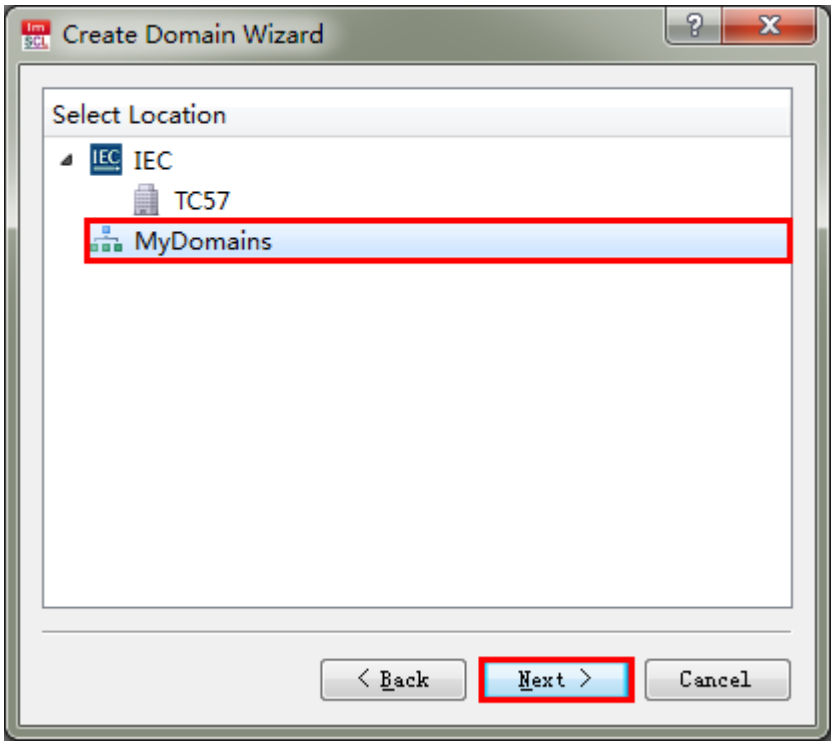
- From toolbar click button



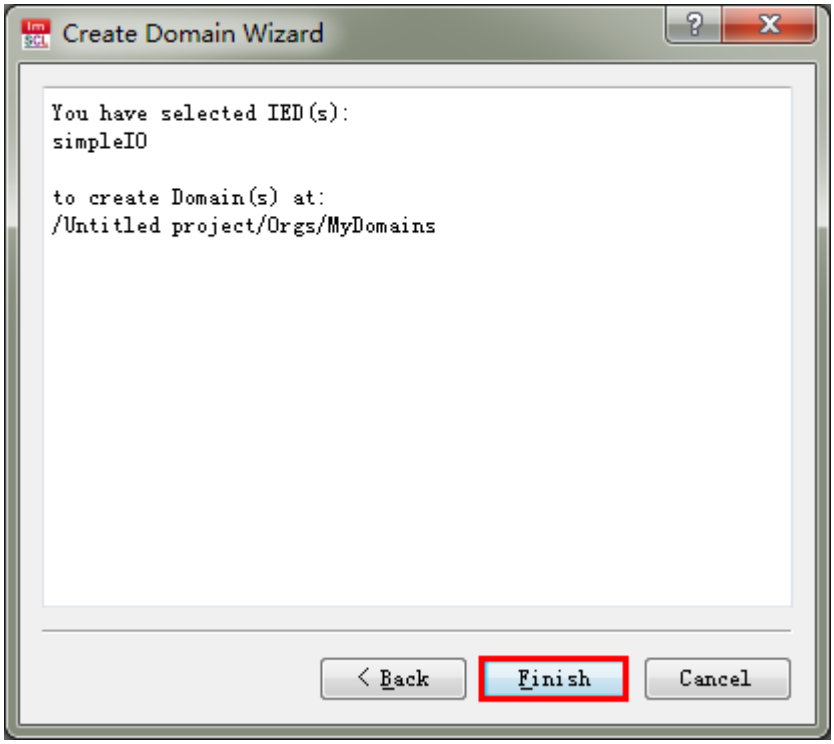
- Select SCL(s) from which Domain(s) are to create



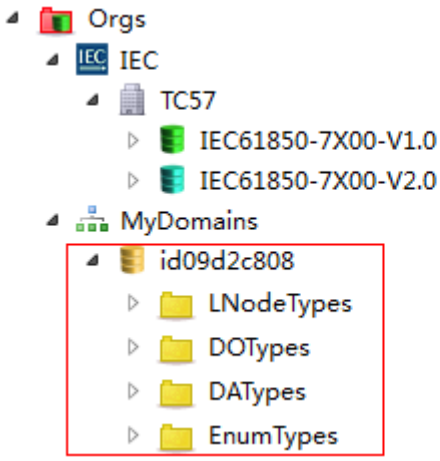
- Select paths to store Domain(s)



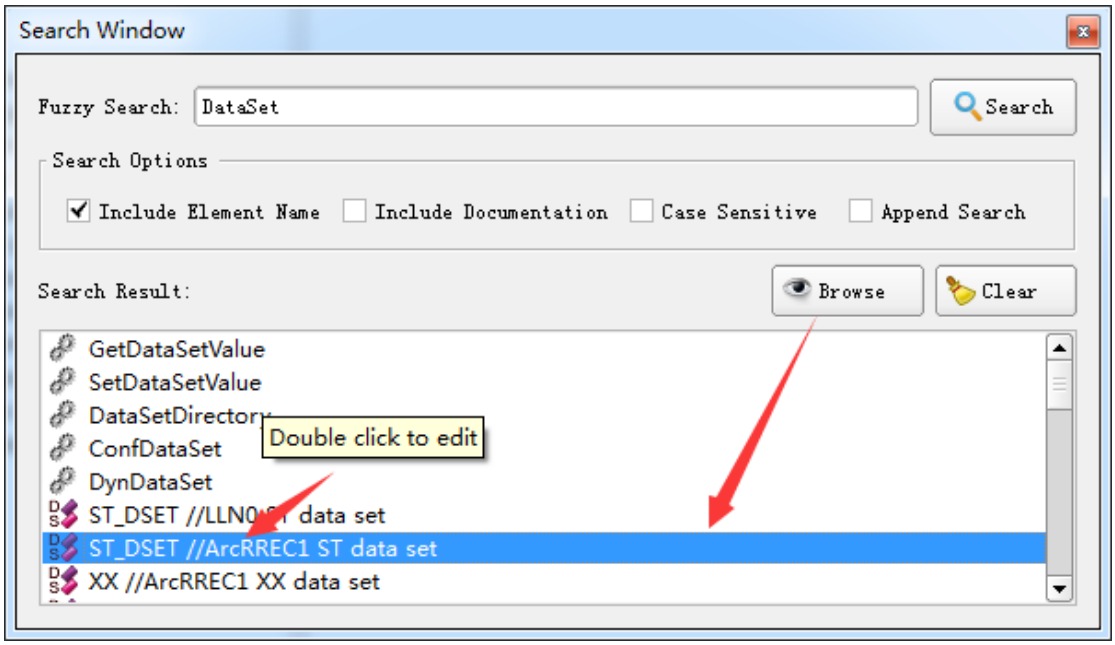
- Click **Finish** when Ready



- After Creation

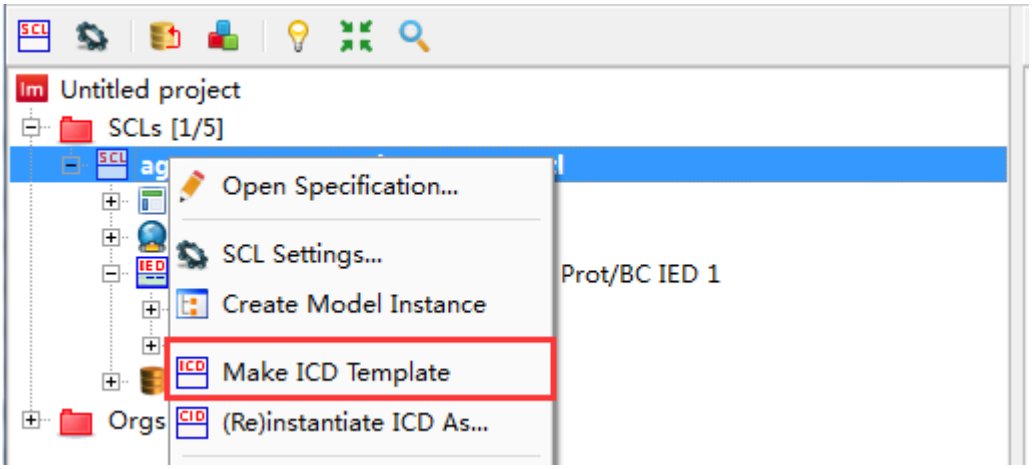


3.17 Project Item Search

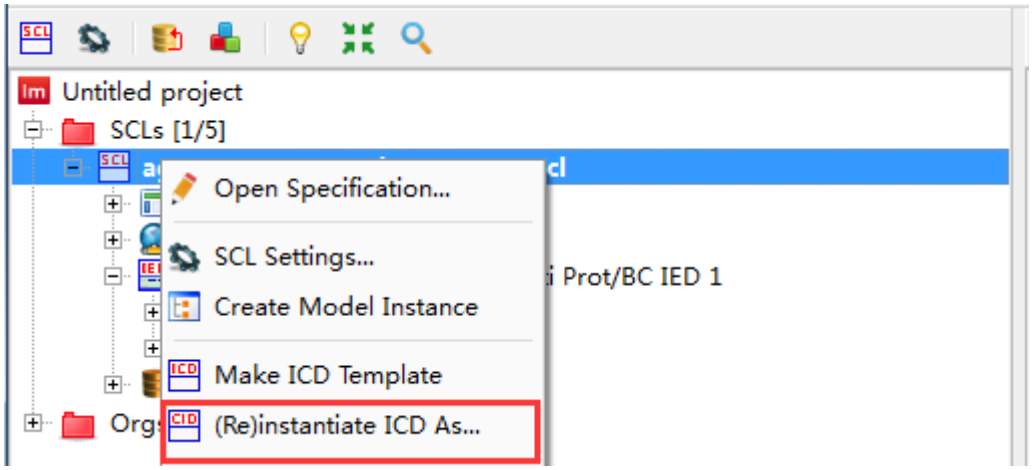


The tool provides comprehensive item search facility.

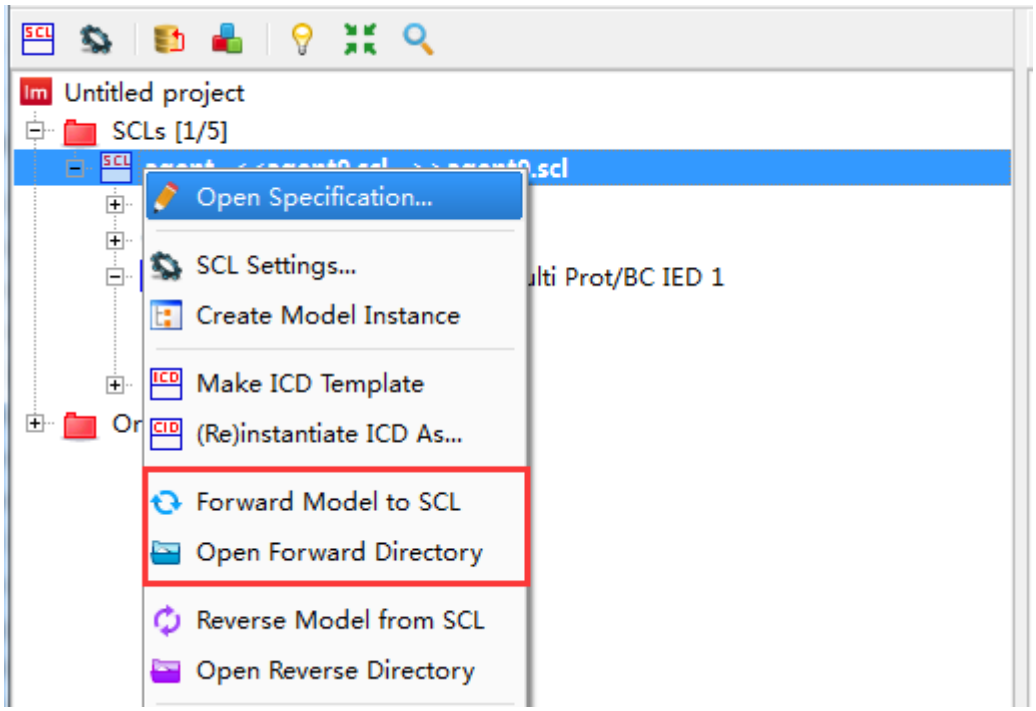
3.18 Make ICD Template



3.19 (Re)instantiate ICD As



3.20 Forward Model to SCL



3.21 Reverse Model from SCL